

# Construction Environment, Health & Safety Manual



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## List of Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-containing material
AHA	activity hazard analysis
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
APCD	Air Pollution Control Division (Colorado)
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BAE	building area engineer
BMPs	best management practices
CCR	Colorado Code of Regulations
CFR	Code of Federal Regulations
CMS	Central Monitoring Station
CPR	cardiopulmonary resuscitation
CRS	Colorado Revised Statute
CSWP	Construction Safe Work Permit
dB	decibels
dBA	decibels, A-weighted scale
DOP	di-octyl phthalate
DOE	U.S. Department of Energy
ECT	equivalent chill temperature
EEWP	Energized Electrical Work Permit
EHS	Environment, Health, and Safety
EPA	U.S. Environmental Protection Agency



FHA	fall hazard analysis
GFCI	ground fault circuit interrupter
HEPA	high efficiency particulate absolute
H&R	hoisting and rigging
IH	industrial hygiene
IPT	Integrated Project Team
LEED	Leadership in Energy and Environmental Design
LO/TO	lockout/tagout
mA	milliamps
MEC	munitions and explosives of concern
MUTCD	Manual on Uniform Traffic Control Devices
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIST	National Institute of Science and Technology
NREL	National Renewable Energy Laboratory
NWTC	National Wind Technology Center
OSHA	Occupational Safety and Health Act, or Occupational Safety and Health Administration
PFAS	personal fall arrest system
POC	point of contact
POD	plan of the day
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RFP	request for proposal
RSO	radiation safety officer
SAIA	Scaffold & Access Industry Association



SDS	safety data sheet
S/CI	suspect and counterfeit items
STM	South Table Mountain
SWPPP	stormwater pollution prevention plan
TTCP	Temporary Traffic Control Plan
TLV	threshold limit value
TWA	time=weighted average
UL	Underwriter's Laboratory
USC	United States Code

# 1 Introduction

The Construction Environment, Health & Safety (CEHS) Manual (hereafter referred to as “this Manual”) has been developed to identify the minimum requirements for Construction Subcontractors and their lower-tier subcontractors (hereafter referred to as “Subcontractor”) which require personnel to perform construction activities at the Department of Energy’s National Renewable Energy Laboratory (NREL) Sites.

## 1.1 Background

It is DOE policy that all construction Subcontractors shall provide a safe and healthful workplace for their personnel. In part, these conditions will be ensured by implementing the worker safety and health program established in 10 CFR Part 851—Worker Safety and Health Program. Each Contractor is responsible for ensuring compliance with “all applicable requirements” that govern their work at NREL facilities, including any consensus standards incorporated therein by reference.

## 1.2 Definitions

**Activity Hazard Analysis:** A work control document that identifies the work tasks, hazards and controls of the work to be performed; and is conveyed to the workers for review, input, acceptance and adherence.

**Competent Person:** One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt, corrective measures to eliminate them. A Competent Person is also one who has extensive training knowledge/experience in a particular activity or job function. A Competent Person at NREL shall be capable of demonstrating the “knowledge and skill-sets” that match their “Competent Person” designation.

**Construction Activity:** Is any combination of erection, installation, assembly, demolition, or fabrication activities involved to create a new facility or to alter, add to, rehabilitate, dismantle, or remove an existing facility. It also includes the alteration and repair (including dredging, excavating, and painting) of buildings, structures, or other real property, as well as any construction, demolition, and excavation activities conducted as part of environmental restoration or remediation efforts.

**Construction Subcontractor:** A person, corporation, or other entity, other than the prime contractor (NREL), who furnishes labor, supplies, materials, equipment, or services in furtherance of the DOE’s mission under a construction or similar contract with NREL including a task order agreement. A construction subcontractor's site tenure may vary depending on the nature of the project, and its employees are not considered a permanent construction force.

**Construction Subcontractor Safety Orientation Checklist:** An NREL form used to document the project relevant ES&H information conveyed to the Construction Subcontractor at the pre-construction meeting. The Construction Subcontractor then has the responsibility to ensure that the content covered in the checklist/orientation is effectively flowed down to all of their employees and their Subcontractors prior to the start of any work.

**Construction Environmental, Health and Safety Plan (CEHSP):** A document prepared by the construction subcontractor and submitted to the NREL EHS Office and Project Manager for review and concurrence. Describes the construction subcontractor's environment, safety and health plan and for a particular construction project and the activity hazard analysis(s) for each definable activity/feature of work.

**Construction Project Manager (NREL):** Building area engineer, technical monitor, or NREL-delegated representative authorized to approve and accept work, provide technical liaison, and interpret NREL plans and specifications on behalf of NREL.

**Subcontractor Safety Officer:** An employee of the construction subcontractor at the work site who is responsible for assisting in the implementation of the construction subcontractor safety plan and compliance with applicable laws and regulations. The qualifications of the Subcontractor's Safety Officer shall be listed in the Subcontractor's Construction Environment, Health & Safety Plan. For some projects, the project specifications may dictate that the Subcontractor have the full-time on-site services of a more highly qualified individual (e.g., Certified Safety Professional, Safety Trained Supervisor, etc.).

**Graded Approach:** Applying a level of rigor commensurate with the importance or significance of the activity, in relation to the associated hazards and consequences to ensure that available resources are used most efficiently and effectively. A Graded Approach is recommended to be used for implementing the work planning and control (i.e., the CEHS Plan and accompanying AHAs). The level of detail within each CEHSP and corresponding AHA should be based on the size, complexity and risk level of the construction project.

**Hold Point:** A point of defined circumstances (i.e., Excavation Permit) beyond which a construction activity must not proceed without the approval of a designated authority.

**Imminent Danger:** A condition or practice that could reasonably be expected to cause death or serious injury, severe property damage, or environmental impairment unless immediate actions are taken to mitigate the effects of the hazard created.

**Non-NREL Site:** Land, buildings, or structures, including installed equipment and utilities, that are used by NREL workers for the conduct of NREL work but are neither leased or government owned specifically for NREL operations. Examples are sites owned by research partners or other government agencies and used by NREL workers for the conduct of NREL business.

**NREL Site:** A geographic area owned or leased by or for the account of the federal government for the performance of Department of Energy program activities. This includes extant building, infrastructure, and other improvements. Some of the areas included in the NREL Site that are more commonly referred to include the South Table Mountain Site, the National Wind Technology Center, Denver West buildings, Golden Office, the Boston Market Building and the Mesa Top site.

**Qualified Person:** One who by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the construction project.

**Subcontractor Administrator:** An NREL employee who is authorized to award and administer a subcontract on behalf of NREL.

**Worker:** A leased worker, subcontractor, independent contractor/consultant, volunteer, or other individual providing construction services to NREL or working on NREL sites.

## 1.3 Layout and Use of this Manual—Imperative Information

### 1.3.1 Scope

This Manual contains excerpts from, and references to, numerous regulations, codes, and standards which are not presented in their entirety. Similarly, not all Environmental, Safety and Health subject matter is covered in this Manual. Each Subcontractor is responsible for ensuring compliance with “all applicable requirements” that govern their work at NREL facilities, including any consensus standards incorporated therein by reference. If the manual does not contain information relative to a particular Environmental, Health or Safety topic, the Subcontractor shall ensure that the governing regulatory provisions or national consensus standards as applicable are implemented as part of their CEHS Project Plan. If there is a conflict between requirements, the Subcontractor is to apply the most stringent unless otherwise directed by the NREL Environmental Health and Safety (EHS) point of contact (POC). Subcontractors are always encouraged to apply best management practices in all of their endeavors.

### 1.3.2 Layout of this Manual

The chapters in this manual are arranged according to topic area and, in general, are laid out in the same format. The chapter will identify who the requirements apply to, the broad regulatory drivers and the Subcontractor’s responsibilities.

Each chapter will also identify any requirements that are specific to the NREL site and/or the Department of Energy. Also presented in each chapter are issues of special emphasis that NREL has identified or for which additional risk control mechanisms are required (i.e., safety plans that shall be submitted for review and acceptance by the Environmental Health and Safety Office, or permits that shall be obtained prior to performing work, etc.).

### 1.3.3 Use of this Manual

**It is the responsibility of the Subcontractor to know, understand and plan for the NREL-specific requirements/special emphasis programs. Further, it is the responsibility of the subcontractor to ensure that their lower tier subcontractors know, understand and comply with the requirements identified in this manual. To help ensure on-going compliance, the prime Subcontractor Superintendent must maintain a hard copy of the current version of this manual on each project.** The NREL-specific requirements may affect what the Subcontractor includes in their Activity Hazard Analyses, impact how the Subcontractor conducts their work, or may affect their project schedule.

## 2 Program Policy

### 2.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) performing construction activities on the NREL Site.

This section provides requirements for identifying key aspects of the Subcontractor environmental, safety and health policies to provide all employees a safe and healthful workplace while also protecting the environment in compliance with the Department of Energy (DOE) and the Occupational Safety and Health Act (OSHA).

### 2.2 Regulatory Requirements

The NREL facilities are Government-owned or leased facilities and subject to 10 CFR 851 Worker Safety & Health Program requirements. While the enforcement provisions of the Occupational Safety and Health Act (OSHA) of 1970 do not apply since the NREL facilities are Government-owned facilities, DOE has exercised its statutory authority to prescribe that all subcontractors will comply with the OSHA Safety and Health Standards for General Industry (29 CFR 1910) and Construction (29 CFR 1926) and DOE will enforce compliance with these standards. The provisions of 10 CFR 851.23 require subcontractors to comply with specific safety and health standards, including:

- Title 29 CFR, Parts 1904.4 through 1904.11, 1904.29 through 1904.33; 1904.44, and 1904.46, “Recording and Reporting Occupational Injuries and Illnesses”
- Title 29 CFR, Part 1910, “Occupational Safety and Health Standards,” excluding 29 CFR 1910.1096, “Ionizing Radiation”
- Title 29 CFR, Part 1926, “Safety and Health Regulations for Construction”
- American Conference of Governmental Industrial Hygienists (ACGIH), “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices” (2005)
- American National Standards Institute (ANSI) Z88.2, “American National Standard for Respiratory Protection” (1992)
- ANSI Z136.1, “Safe Use of Lasers” (2000)
- ANSI Z49.1, “Safety in Welding, Cutting and Allied Processes,” Sections 4.3 and E4.3 (1999)
- National Fire Protection Association (NFPA) 70, “National Electrical Code” (2005)
- NFPA 70E, “Standard for Electrical Safety in the Workplace” (2004)
- Title 10 Code of Federal Regulations (CFR) 850, “Chronic Beryllium Disease Prevention Program.”

Other regulations are listed at 10 CFR 851.23, but may not be applicable depending upon the construction activities. It must be understood that 10 CFR 851 provides the basic foundation for

a worker safety and health program and that Subcontractors may need to go beyond the Rule's minimum requirements in establishing programs to protect workers from hazards associated with their activities.

## **2.3 NREL Specific Requirements**

### **2.3.1 Construction EHS Plan**

Each Subcontractor performing construction work at NREL is required to develop a Construction Environmental, Health & Safety Plan (CEHSP) prior to conducting any work activities on site. The Subcontractor shall ensure that the requirements in this Manual are incorporated into their CEHSP and the associated Activity Hazard Analyses (AHAs). The CEHSP shall be submitted in accordance with the contract requirements document and undergo a review and concurrence by the NREL Project Manager and the EHS POC prior to the Subcontractor being allowed to start work.

NREL provides each Subcontractor with an electronic copy of the CEHSP template that shall be utilized for their Plan. A new CEHSP shall be submitted for each construction project, regardless of whether the Subcontractor has performed prior work at NREL. The template is provided in electronic format to enable cut-and-paste functions for those subcontractors whose basic data remains unchanged, yet tailor the hazard and controls information to the particular activities/materials/location of the project at-hand. Similarly, the core safety management mechanism, the activity hazard analysis, is provided in electronic format to make production of the AHA as easy as possible yet project specific (see Section 4.3).

NREL recommends using a graded approach in the development of CEHSPs. This approach determines the level of rigor for implementing the work planning and control attributes based on the importance/significance of the activity in relation to the associated hazards and consequences. The level of detail within each CEHSP and corresponding AHA should be commensurate with the size, complexity and risk level of the construction project.

Field changes (i.e., red line, pen/ink changes) to the CESHP are acceptable. All affected Subcontractor personnel involved in the work being performed shall review the CEHSP and any subsequent changes. The updated CEHSP shall be made available for review and concurrence by the NREL Project Manager and the EHS POC. The CEHSP shall be kept at the worksite and available for review.

### **2.3.2 Training and Documentation**

For all Subcontractor workers at NREL, site-specific environmental, health and safety orientation training will be required in accordance with Section 5.3.6. This orientation will be documented by having each affected worker sign the Subcontractor Safety Orientation Checklist.

For work activities in which specific training is required by safety regulations (e.g., OSHA mandated), the subcontractor shall maintain records on-site, showing proof of current training records for any particular qualified individual(s). Designated "Competent Persons" are expected to have a higher level of experience, training and qualification. Subcontractors shall have in place a mechanism to verify that the "Competent Person(s)" knowledge and skill-sets match their "Competent Person" designation (i.e., written test, training certifications).

Additional requirements to provide verification of worker training are identified on the CEHSP template. Photocopies of training certificates, certification cards, wallet IDs, etc. identifying the individual, the specific training, who conducted the training and the date completed (and/or expiration date) are accepted in lieu of originals.

In addition, NREL may require some projects to have specific qualifications for their designated on-site safety representative (e.g., 10- or 30-hour Construction Safety, Safety Trained Supervisor, Board of Certified Safety Professionals Certification), depending upon the complexity of the project and the hazards involved. NREL will identify this requirement in the request for proposal.

### **2.3.3 Safety Bulletin Boards**

The Subcontractor is responsible for installing and maintaining a safety bulletin board at the location where the majority of employees report to work. Workers shall be advised of the location of the nearest bulletin board. Employees shall be responsible for reviewing the bulletin board to keep informed of safety-related information. Safety bulletin boards shall be sufficient size to display and post safety bulletins, newsletters, posters, accident statistics, and other safety educational material. At a minimum, the safety bulletin board shall display:

- DOE Occupational Safety and Health Poster DOE-F 5480.2 (Your Rights as a Worker)
- DOE Occupational Safety and Health Complaint Form 5480.4
- Requirements, provisions and number of the Employee Concern Program Hotline (Whistleblower Protection)
- Citations and notices as appropriate
- OSHA 300A form during February 1 to April 30
- NREL-furnished safety bulletins and publications
- Stormwater discharge permit notice (as applicable).

Suggested additional items to be posted include:

- Topical safety and health posters
- Minutes of safety meetings
- Information on accidents and lessons learned
- Hazard communication information.

### **2.3.4 Subcontractor Incident Response and Notification**

The Subcontractor shall report all incidents and near misses, no matter how minor, to the NREL Project manager as soon as the scene is stabilized, but in all cases notification shall be made within one hour of occurrence. This reporting time frame is necessary in order that DOE can be notified within their prescribed time requirements and so that any necessary accident investigation, scene security, cleanup, traffic rerouting, etc. may begin.



For all emergencies at the NREL site (excluding the National Wind Technology Center), the subcontractor shall contact the Security by:

- Utilizing any building red phone
- Dialing extension 1234 from the building landline
- By calling (303) 384-6811 from any outside line (cell phone)

**Note:** DO NOT call 911, as this will cause confusion and delays. The Central Monitoring Station (CMS) will coordinate and direct the emergency response services to your location.

- For work at the NWTC, the subcontractor shall call 911 and then call security at 303 384-6811. All other incident response requirements apply to work at the NWTC.

For large construction projects or projects independent of NREL Buildings, the subcontractor, as part of their emergency response plan, must designate a member(s) of their staff, who has the authority and is capable of directing emergency response on the job site. This individual will act as the communication point of contact between internal (NREL) and external agencies and is responsible for the coordination of an on-scene emergency situation from initial response through stabilization in coordination with the incident commander (West Metro). For construction projects associated with existing NREL buildings, the NREL BEC will direct the emergency response actions until West Metro arrives.

The subcontractor must provide and identify the method for prompt notification to NREL's Central Monitoring Station (CMS)/Security via landline, cell phone or contractor provided radio.

A site map showing assembly points and directions to the Subcontractor's authorized medical facility shall be posted at on site at the project location (e.g., site project office) and included as part of their CEHS Project Plan (this should be the last page of the CEHSP to facilitate easy of retrieval). A copy shall also be posted at the Subcontractor's project field office. Upon award of the work, contact the Project Manager or EHS Point of Contact for electronic copies of building evacuation routes and assembly areas to include in the CEHS Plan's map(s), as needed.

### ***2.3.5 NREL Response to Emergencies on Major Construction Sites***

Upon notification of an emergency situation on major construction sites, NREL will provide notification to external and internal responders. Internal responders include: EHS Construction POC's, Security & Emergency Preparedness personnel, and Construction/Project Managers.

NREL Internal responders will be required to have completed the Site Specific Safety Orientation (subcontractor provided) and must have the minimum required PPE. Other stipulations include:

- Health and Safety staff has no medical response responsibilities. Only H&S construction POCs shall respond to major construction incidents (medical or otherwise). Other properly oriented and trained EHS staff may respond to provide support and direction in accordance with established procedures (such as spills).
- Occupational nurse response shall be at the request of the subcontractor.

- Occupational nurses may respond to the construction site administration area and offer services. Access/response to the injured worker's location shall be only at the request of the subcontractor.
- Occupational nurse PPE will be a minimum of sturdy footwear, safety glasses and hardhat. In the absence of this PPE, no response will be provided.
- Even if requested by the subcontractor, occupational nurse response is not guaranteed—workload and availability may preclude a response.

### **2.3.6 Construction Subcontractor Event Investigation**

After the response has occurred and the scene is stabilized and secure the subcontractor must initiate an event investigation and/or participate with the EHS event investigation, as determined by NREL. There is an expectation and responsibility to fully understand what occurred, the causation of the event and the identification of corrective actions. The subcontractor is further responsible for the prompt implementation of corrective actions for deficiencies identified through an EHS event investigation, or as reported by DOE, the project manager, EHS Office, or other authorities having jurisdiction.

### **2.3.7 Construction Subcontractor Initial Screening Process**

All NREL construction subcontractors and all their lower-tier subcontractors are required to meet pre-established EH&S risk criteria prior to being awarded a subcontract to perform construction work at NREL sites. The NREL Contracts and Business Services (C&BS) Office includes the Environment, Health, and Safety Subcontract Risk Evaluation Worksheet as part of construction solicitations and confirms and verifies that all potential subcontractors and lower-tier subcontractors have properly completed the worksheet. NREL C&BS will complete an initial review of the subcontractor or lower-tier Experience Modification Rate (EMR).

The Subcontractor is responsible for ensuring that all of their lower-tier subcontractors EH&S Subcontract Risk Evaluation Worksheets are submitted to NREL C&BS for review and NREL approval prior to performing work on an NREL site. All subcontractors are required to meet the minimum EMR of 1.0. Additional information regarding the subcontractor screening process can be found on the NREL Construction Subcontractor EH&S extranet website located at <http://www.nrel.gov/extranet/ehs/>.

## **2.4 NREL Special Emphasis**

### **2.4.1 Integrated Safety Management (ISM) System**

The Subcontractor shall incorporate the elements of ISM into their CEHSP that conforms to the National Renewable Energy Laboratory's (NREL) Integrated Safety Management requirements. An effective ISM plan establishes a single system that integrates requirements into the work planning and execution process to protect the workers, public, and the environment. NREL implements the following five core ISM functions for work activities that could potentially affect workers, the public, or the environment and applies them as a continuous cycle with the degree of rigor appropriate to address the type of work activity and the hazards involved.

- **Define the Scope of Work.** Translate missions into work, set expectations, identify and prioritize tasks, and allocate resources.

- **Analyze the Hazards.** Identify, analyze, and categorize hazards and potential environmental impacts associated with the work.
- **Develop and Implement Hazard Controls.** Identify and agree upon standards and requirements, identify controls to prevent/mitigate hazards, establish the EHS parameters, and implement controls.
- **Perform Work Within Controls.** Confirm readiness and perform work safely and in the prescribed manner to protect workers, the public, and the environment.
- **Provide Feedback and Continuous Improvement.** Gather feedback on the adequacy of controls from workers and appropriate stakeholders, identify and implement opportunities for improvement, and conduct line management and independent oversight.

Subcontractor program flexibility is understood and encouraged as long as the Subcontractor's program tenets adequately address the spirit and intent of the ISM provisions. For specific information on instituting an ISM program, refer to DOE document, "[DOE M 450.4-1, Integrated Safety Management System Manual](#)."

#### 2.4.2 Stop Work Authority

If unanticipated/unsafe conditions are identified or non-compliant practices are observed during construction activities, workers shall be instructed stop the work immediately and notify their supervisor and health & safety officer of this action. All workers at NREL sites have the authority to stop work. Work may not proceed until the circumstances are investigated and deficiencies corrected.

### 2.5 General Subcontractor Responsibilities

As required in 10 CFR 851, the Subcontractor shall establish a worker safety and health program. Worker protection measures should be based on the use of a graded approach to ensure that available resources are used most efficiently and effectively. Worker safety and health programs shall be integrated into other related site-specific worker protection activities and within the integrated safety management system. There must be an open and continuous line of communication between the Subcontractor and NREL to discuss any unsafe acts or conditions that may arise during the project. The basis for the implementation of the Subcontractor Worker Safety and Health Program will be contained in the CEHSP.

The Subcontractor has overall accountability for the safety of their project and shall allocate the resources necessary for implementing all required safety-related codes and contract/subcontract requirements. The subcontractor shall:

- Follow all NREL site specific environmental, health and safety (EHS) requirements and associated permits as defined by this manual.
- Establish EHS flow-down requirements in all subcontracts.
- Implement the appropriate requirements of this manual into the CEHSP.
- Designate a Subcontractor Safety Officer/designated on-site safety representative to oversee all activities.

- Develop, implement, and/or adhere to activity hazard analyses (AHA) and other pre-job planning documents required by this manual.
- Provide training to employees in safe-work practices.
- Document all required training and have available for review.
- Provide required personal protective equipment (PPE), training employees on how to use the equipment and enforcing its use in the field.
- Monitor the workplace for unsafe conditions and take immediate action to correct unsafe conditions, acts, and other deficiencies identified during inspections.
- Perform necessary personal exposure monitoring.
- Coordinate and conduct pre-job planning with subcontractors, field supervisors, affected lab managers, and others, as required.
- Conduct a daily walk-around safety inspection and document this inspection.
- Instruct all employees, initially and periodically, on matters pertaining to employee safety and health rights, protections, obligations, and responsibilities.

## 2.6 References

- 10 CFR 851, Worker Safety & Health Program
- 29 CFR 1926, Safety and Health Regulations for Construction
- 29 CFR 1910, Occupational Safety and Health Standards for General Industry.

## 3 Occupational Medicine

### 3.1 Applicability

The requirements of this section apply to all Construction Subcontractors' and lower-tier subcontractors' (hereafter referred to as "Subcontractor") activities which require personnel to work on NREL Sites if *either* of the two criteria applies:

- The Subcontractor's workers are on site for more than 30 days in a 12 month period
- The Subcontractor's workers on site are enrolled for any length of time in a medical or exposure monitoring program required by any rule or other obligation.

### 3.2 Regulatory Requirements

The Subcontractor shall establish and provide comprehensive occupational medicine services to workers on the site, as required in Appendix A.8. of 10 CFR Part 851—Worker Safety and Health Program.

### 3.3 NREL Specific Requirements/Permits

Where applicable, NREL requires Subcontractors to submit health and safety plans that document compliance with the occupational medicine provisions contained in Appendix A.8. to 10 CFR Part 851—Worker Safety and Health Program (see Section 3 of the CEHSP).

### 3.4 NREL Special Emphasis

The occupational medicine requirements in 10 CFR Part 851 are unfamiliar to many Subcontractors and "flowing down", or transferring the responsibility for compliance with these requirements to lower-tier subcontractors, is irregular and generally tends to lack proper oversight to ensure high quality compliance. Further, Subcontractors may fail to inform occupational medicine services providers of their responsibilities specified in 10 CFR Part 851—Worker Safety and Health Program, which is a regulation unique to DOE sites and applicable at NREL.

### 3.5 Subcontractor Responsibilities

The Subcontractor is responsible for compliance with Appendix A.8. of 10 CFR Part 851—Worker Safety and Health Program, including: the accurate and timely flow down of these requirements to all of their lower-tier subcontractors, and, for insuring that all of their lower-tier subcontractors comply with these requirements.

The Subcontractor is responsible for providing their occupational medicine services providers access to worksite hazard information.

- The Subcontractor is responsible for coordinating with the NREL project manager and providing the occupational medicine services provider with access to the following:
  - Current information about actual or potential work-related site hazards (chemical, radiological, physical, biological, or ergonomic)
  - Employee job-task and hazard analysis information, including essential job functions

- Actual or potential work-site exposures of each employee
- Personnel actions resulting in a change of job functions, hazards, or exposures.
- Subcontractors shall notify the occupational medicine services providers when an employee has been absent because of an injury or illness for more than five consecutive workdays (or an equivalent time period for those individuals on an alternative work schedule).

The Subcontractor and occupational medicine services provider is responsible for developing and maintaining a record, containing any medical, health history, exposure history, and demographic data collected for the occupational medicine purposes, for each employee for whom medical services are provided. All occupational medical records shall be maintained in accordance with Executive Order 13335, Incentives for the Use of Health Information Technology.

The Subcontractor is responsible for notifying the occupational medicine services provider of the requirements contained in Appendix A.8. of 10 CFR Part 851—Worker Safety and Health Program. The occupational medicine services provider and Subcontractor are responsible for implementing and ensuring compliance with the following requirements:

- The occupational medicine services provider determines the content of the worker health evaluations.
  - Workers shall be informed of the purpose and nature of the medical evaluations and tests offered by the occupational medicine services provider.
  - The occupational medical provider shall determine the necessary health evaluations.
  - Diagnostic examinations will evaluate employee's injuries and illnesses to determine work-relatedness, the applicability of medical restrictions, and referral for definitive care, as appropriate. After a work-related injury or illness or an absence due to any injury or illness lasting 5 or more consecutive workdays (or an equivalent time period for those individuals on an alternative work schedule), a return to work evaluation will determine the individual's physical and psychological capacity to perform work and return to duty. At the time of separation from employment, individuals shall be offered a general health evaluation to establish a record of physical condition.
- The occupational medicine services provider shall monitor ill and injured workers to facilitate their rehabilitation and safe return to work and to minimize lost time and its associated costs.
- The occupational medicine services provider shall include measures to identify and manage the principal preventable causes of premature morbidity and mortality affecting worker health and productivity.
  - The Subcontractor shall include programs to prevent and manage these causes of morbidity when evaluations demonstrate their cost effectiveness.

- The occupational medicine services provider shall review and approve the medical and behavioral aspects of employee counseling and health promotional programs, including the following types:
  - Subcontractor-sponsored or Subcontractor supported EAPs
  - Subcontractor-sponsored or Subcontractor supported alcohol and other substance abuse rehabilitation programs
  - Subcontractor-sponsored or Subcontractor supported wellness programs.

### 3.6 References

- 10 CFR Part 851 Appendix A—Worker Safety and Health Functional Areas
- 10 CFR Part 851—Worker Safety and Health Program
- Executive Order 13335—Incentives for the Use of Health Information Technology
- 10 CFR 712.38(b)(2)—Maintenance of medical records
- 5 USC Sec. 552a.—Records maintained on individuals
- 10 CFR Part 1008—Records maintained on individuals
- 29 CFR 1910.1020—Access to employee exposure and medical records
- 42 USC Sec. 7384—Energy Employees Occupational Illness Compensation Program Act.



## **4 Construction Hazard Identification and Control Process**

### **4.1 Applicability**

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) construction work activities on NREL Sites unless otherwise specifically exempted by NREL. This section provides the requirements for establishing a method for identifying, controlling, and documenting hazards associated with Subcontractor work activities and communicating this information to all affected workers.

### **4.2 Regulatory Requirements**

Subcontractor methods for identifying, controlling, and documenting hazards associated with subcontractor work activities shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926, Construction
- 29 CFR 1910, General Industry
- 10 CFR 851, Worker Safety and Health Program.

### **4.3 NREL Specific Requirements/Permits**

In addition to Section 4.2, all Subcontractor work activities shall meet the following specific NREL requirements for hazard identification and control.

#### **4.3.1 General Requirements**

The Subcontractor is responsible for understanding the scope of work in sufficient detail to ensure that the work is effectively planned for each definable work activity, the hazards associated with the work are identified and the planned protective measures are implemented. This shall be accomplished utilizing the activity hazard analysis (AHA) process described in Section 4.3.2 below. These analyses shall be listed in the CEHSP. The CEHSP Template provides additional guidance on developing AHA's, in addition to completed example AHA templates to assist the subcontractor in the development of their AHAs.

#### **4.3.2 Activity Hazard Analyses**

For each separately definable construction activity (e.g., excavations, foundations, structural steel, roofing, electrical, mechanical, etc.) the subcontractor shall develop an activity hazard analysis (AHA) prior to commencement of the associated work/definable feature. A definable work activity is a task which is separate and distinct from other tasks, has separate control requirements. A definable work activity may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Within each definable work activity there may be other sub-phases of work which warrant separate AHAs. It will be the responsibility of the Subcontractor to determine the best break-down of separately definable activities and the subsequent work steps in order to produce clear, concise, and effective, AHAs. The Subcontractor AHAs shall be kept at the worksite and available for review by NREL.

NREL recommends using a graded approach in the development of AHAs; however, the Subcontractor AHAs shall be developed in sufficient detail to preclude confusion and misunderstanding and shall be commensurate with the size, complexity and risk level of the construction project. When used appropriately, the graded approach will incorporate the level of rigor for implementing the work planning and control attributes based on the importance/significance of the activity in relation to the associated hazards and consequences.

The analyses shall contain and/or meet the following elements as applicable to the activity:

- Identification of the definable work activity
- Identification of the job steps for each work activity
- Identification of the foreseeable hazards for each step/activity and the planned protective measures to include appropriate protective devices and/or equipment as needed
- Identification of competent persons required for workplace inspections of the construction activity, where required by OSHA standards
- Identification of Emergency Response Action relative information (e.g., gas shutoff valve location, etc.)
- Identification of project-required hold-points or other logistical requirements
- Address additional hazards revealed by supplemental site information (e.g., site characterization data, as-built drawings)
- Provide drawings and/or other documentation of protective measures for which applicable Occupational Safety and Health Administration (OSHA) standards require preparation by a Professional Engineer or other qualified professional
- Review and approval of the AHA by the Subcontractor's Management
- Made available for review to the NREL Project Manager and NREL EHS prior to the start of work activities
- Places for signatures of the involved workers to signify that they have been briefed on and understand the requirements of the AHA, and acknowledge their intended compliance with the AHA. Attach additional signature pages as needed.

The completed AHA shall be made available for review to the NREL Project Manager/designee and EHS POC.

The subcontractor shall conduct a pre-task/phase meeting that discusses the corresponding AHA, the work tasks, and associated procedures and hazards with all affected parties to identify and coordinate logistics, controls and communications required for the activity. Each worker involved in that work must review and sign the AHA prior to performing work. All AHAs must be kept at the work site to be available for review by workers and oversight personnel.

If, while working, it is discovered that the controls addressed in the AHA will not/do not provide adequate protection then the task at hand shall be stopped and not be conducted until the hazards have been re-assessed, the AHA updated, and adequate controls implemented. In these instances, the subcontractor may utilize field changes (i.e., red line, pen/ink changes) as needed to reflect

changing conditions associated with the activity. All affected contractor personnel involved in the work being performed shall review each AHA and subsequent updates/changes. The updated AHA shall be made available for review to the NREL Project Manager and EHS POC.

#### **4.3.3 Worker Training**

The Subcontractor shall ensure that affected workers are made aware of the foreseeable hazards and the protective measures described within the activity analysis prior to beginning work on the affected activity.

#### **4.3.4 Record of Training**

The Subcontractor shall ensure that workers acknowledge being informed of the hazards and protective measures associated with assigned work activities and understand those requirements. Each worker involved in that work must sign the AHA prior to performing work.

### **4.4 Subcontractor Responsibilities**

The provisions of this procedure apply to the development and implementation of the Subcontractor's Hazard Identification and Control program. The Subcontractor shall be responsible for implementing an effective Hazard Identification and Control program that:

- Identifies, evaluates, and controls potential and existing hazards/agents in the workplace through the pre-job safety planning process.
- Incorporates the controls into the activity hazard analyses
- Determines that engineering devices, administrative controls, and personal protective equipment are available, appropriate, tested, and utilized by employees
- Determines employees are trained as required
- Have provisions to manage and notify NREL when there are changes related to the work scope, materials, and/or processes that may introduce new or different hazards to the project.

### **4.5 References**

- 10 CFR 851, Worker Safety and Health Program
- NREL Laboratory Level Procedure 6-1.51, Construction Environment, Health and Safety
- 29 CFR 1926, Construction Standards
- 29 CFR 1910, General Industry Standards.

## **5 EHS Meetings, Inspections, and Orientations**

### **5.1 Applicability**

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) performing construction activities on NREL Sites unless otherwise specifically exempted by the NREL.

### **5.2 Regulatory Requirements**

Subcontractors will be responsible for implementing a system for conducting EHS meetings, inspections and employee EHS orientations that will facilitate compliance as applicable with the following statutory requirements:

- 29 CFR 1926, Construction Standard
- 29 CFR 1910, General Industry Standard
- Environmental Protection Agency Requirements.

### **5.3 NREL Specific Requirements**

In addition to Section 5.2, all Subcontractor EHS meetings, inspections and orientations, as applicable to the scope of the construction work activities and supporting offices/facilities shall meet the following specific NREL requirements.

#### **5.3.1 Daily EHS Activity Briefings**

EHS activity briefings shall be held each day prior to the start of work activities. The flexibility exists for each Subcontractor to integrate these requirements into their existing EHS program format as long as the required information is effectively provided to employees and documentation for these briefings and/or meetings is maintained. This may be accomplished through daily construction meetings, plan of the day (POD) meetings (see Section 5.3.2), pre-task activity reviews or other means which prove to be effective in the dissemination of the required information and has been accepted by NREL. Records for these briefings documenting the meeting content and attendance shall be maintained. All crew members shall acknowledge the information disseminated, by signing the attendance roster.

The briefing content shall include at a minimum the following topics:

- EHS pre-task planning for the day’s work activities
- Changes in work practices or environmental conditions
- Required equipment/system daily inspections
- Previous days incidents, near misses, lessons learned and/or other relevant issues as applicable
- Other ongoing activities that may have project EHS implications or may impact NREL operations
- New or modified site-wide procedures or requirements

- Review of AHA for new activities and/or revised existing AHAs.

### **5.3.2 Plan of the Day Meeting**

The plan of the day (POD) process is required to maintain daily positive control and to establish a high level of communication between subcontractors prior to the start of construction activities for the day. An acceptable POD form shall be provided by the NREL Project Manager.

The basis of the POD process is in preplanning. First-tier subcontractors and all lower-tier subcontractors shall identify all planned tasks on a POD form. The level of detail must be appropriate to define all tasks that may present a hazard to people, property or environment. The listed task(s) shall include the corresponding AHA(s). If the proposed task does not have a corresponding AHA, then a new AHA will need to be developed and reviewed prior to the work moving forward.

All crew members shall acknowledge the POD (daily “tailgate meeting”) by signing an attendance roster for the POD/AHA.

On Congressional Line Item (CLI) projects the below additional structure/requirements apply:

The completed POD must be submitted to the first-tier Subcontractor for review against conflicting operations, regulatory hold points, required permits and with an acceptable level of detail. The plan must be submitted in a timely fashion (preferably the day before) to ensure that the first-tier subcontractor can perform a quality review of the plan. A representative for each subcontractor performing work that day must have submitted their proposed POD/AHA to the first-tier subcontractor superintendent or designee prior to the start of the meeting for review and work approval. The first-tier subcontractor shall record what subcontractors were in attendance at the POD. Subcontractors that are not present at the POD shall not be authorized to perform work until their POD/AHA is submitted and approved by the first-tier subcontractor.

During the POD meeting, each subcontractor must present their POD work activities to the first-tier subcontractor and the other lower tier subcontractor representatives in attendance. The first-tier subcontractor should have available a size “D” drawing or other effective project pictorials (TV monitors) that can be referenced during the POD meeting. Each subcontractor representative must describe the activities for the day by pointing to where the work will be conducted on the visual aid provided, identify the necessary equipment/tools, equipment travel logistics and required permits to perform the work.

Upon completion of the initial POD/AHA meeting, each subcontractor is then required to have break-out sessions (daily “tailgate” meeting) with each work crew member prior to the start of each work shift, or when an individual arrives at work. The meeting shall include a discussion of the specific POD and corresponding AHA for their work and additional safety topics of interest related to the site. Applicable, additional items, identified in Section 5.3.1 of this manual shall also be discussed.

If during the course of the day, additional task(s) need to be performed that are not identified on the POD, then the subcontractor’s responsible supervisor shall add this task to the POD, revise the AHA as necessary, receive approval from the first-tier subcontractor superintendent or

designee and then brief the affected crew of the work task changes and revised AHA. Affected crew members must initial and date their re-review of the POD/AHA.

### **5.3.3 Monthly EHS Meetings**

A monthly construction EHS meeting shall be held for all projects exceeding thirty days and shall include attendance by all site Subcontractor and lower-tier subcontractor personnel. NREL reserves the right to increase the frequency of these meetings based upon project complexity/risk and/or Subcontractor EHS performance. Supervisors, foremen or other designated personnel shall conduct these meetings. Meetings can be held for the entire project or smaller breakout meetings can be held for each subcontractor and/or craft. A record of each meeting, documenting the meeting content and attendance shall be maintained.

At a minimum, monthly EHS meetings shall include:

- EHS, health, and job-related issues/concerns related to the particular operation
- Summary of relevant lessons learned from NREL and/or other Subcontractor projects as applicable
- As applicable, accident investigations conducted since the last meeting, to discuss if the cause of the unsafe acts or conditions were properly identified and corrected
- EHS inspection findings since the last meeting
- Ad hoc EHS or special emphasis training
- Other relevant EHS subject matter as determined by the Subcontractor or NREL.

### **5.3.4 Daily EHS Inspections and Permits**

The Subcontractor shall ensure a supervisor, safety officer and/or competent person(s) conducts daily safety inspections of the general operations in project areas.

The subcontractor shall also ensure a supervisor, safety officer, qualified person and/or competent person(s) issues and/or conducts any regulatory-required permits or documented inspections applicable to the worksite, materials and equipment. The subcontractor must ensure that all NREL required permits have been issued. These inspections and/or permits include but are not limited to:

- Cranes
- Confined space entry
- Excavations
- Material handling equipment
- Heavy equipment
- Scaffold systems
- Aerial lifts
- Hot work

- Building surface penetrations
- Environmental (as required).

The Subcontractor shall maintain written inspection records and/or permits and make them available for review. The Subcontractor shall prohibit the use of any machinery, tool, material, equipment or worksite condition that is not safe and/or does not comply with applicable requirement of these standards. Tools and equipment brought onto the site for use shall be new or like new condition.

During the inspection(s) any identified defective or unsafe equipment, tools and/or worksite locations shall be immediately corrected, tagged/barricaded, removed from the jobsite and/or other effective interim control measures taken.

### **5.3.5 Weekly EHS Inspections**

#### **5.3.5.1 Weekly Site Wide EHS Inspections**

The Subcontractor shall conduct and document regular (at least weekly) EHS inspections of the worksites, materials, equipment, and construction operations. At a minimum, the Subcontractor superintendent/supervisor and the NREL Project Manager shall be part of this inspection. Coordination with the EHS POC shall be made in advance of these inspections to afford EHS the opportunity to accompany the inspections. NREL reserves the right to increase the frequency of these inspections based upon project complexity/risk and/or Subcontractor EHS performance.

The following factors influence the frequency of inspections:

- Number and type of hazards involved
- Total level of risk to workers, property, and environment
- Previous experience with the Subcontractor
- Duration of the project
- Time elapsed since the last inspection
- Changes in scope of work.

The Subcontractor shall maintain written inspection records and make them available for review upon request. The inspection report shall identify the hazard and the corrective actions taken or the corrective action plan with closed or anticipated completion date(s). Copies of the inspection results shall be presented at the weekly construction meeting or other NREL accepted means as applicable to the project.

During the inspection(s) any identified defective or unsafe equipment, tools and/or worksite locations shall be immediately corrected, tagged/barricaded, removed from the jobsite and/or other effective interim control measures taken.

Weekly inspection will be rated by NREL and result in one of four possible outcomes; Superior, Excellent, Satisfactory and Unsatisfactory. Depending on the contract language, these ratings may directly impact award fees or otherwise influence the ability of the subcontractor to bid future projects.



### **5.3.5.2 Gang Box Inspections**

Prior to arriving on site, each subcontractor shall perform inspections of all equipment, tools and materials stored in the gang boxes. Defective tools and equipment shall be removed from the box prior to arriving on the site.

All gang boxes located on the site shall receive weekly documented inspections of equipment, tools and materials in the gang box. The inspection must be performed by the subcontractor designated competent person.

The Subcontractor shall maintain written inspection records within the gang box signed by the competent person performing the inspection.

All tools and equipment brought onto the site for use and/or stored in the gang box shall be new or like new condition.

During the gang box inspection(s) any identified defective or unsafe equipment, tools or materials shall be immediately corrected, tagged or removed from the jobsite.

### **5.3.6 Subcontractor Employee EHS Orientation**

All Subcontractor employees working at NREL are required to receive Construction Subcontractor EHS Orientation prior to the start of any work activities. The Subcontractor will receive a Construction Subcontractor Orientation by NREL at the pre-construction meeting. The Subcontractor shall ensure that the content covered as part of this orientation and any other project relevant EHS information is effectively flowed down to all Subcontractor employees prior to the start of any work. The Subcontractor shall maintain a detailed outline of the orientation. A record of these orientations, documenting the meeting content and attendance shall be maintained on-site by the subcontractor and available for review by NREL.

### **5.3.7 Bilingual Requirements**

All subcontractors shall ensure that bilingual supervisors and trainers are available as necessary for orientations, training, meetings and workplace supervision to ensure effective communication is maintained for “Non-English” speaking members of the workforce.

Bilingual EH&S posters, labels, signs and barriers shall be utilized as necessary to promote effective communication when members of the workforce are “Non-English” speaking.

## **5.4 NREL Special Emphasis**

### **5.4.1 Weekly EHS Report**

Weekly EHS reports shall be compiled and maintained as part of the project record and made available for review by NREL. The weekly EHS report shall be available by each Tuesday for the previous week’s activities. This report may be maintained as a hard copy report (on-site) or on the FTP/project website. The report shall contain the following information as applicable for the week:

- Brief summary of significant EHS activities

- Copies of daily, weekly and/or monthly EHS meeting documentation and attendee sign-in sheets
- Copies of completed daily, weekly or monthly site inspections and corrective actions
- Copies of initial or any daily inspections performed such as excavation inspections, hoisting and rigging inspections, and vehicle or equipment inspections
- Copies of any integrated personal sampling results, including data sheets, laboratory analytical results, exposure calculation sheets, and direct reading monitoring results/reports
- Copies of any permits used for the week including excavation permits, hot work permits, lockout/tagout documentation, and confined space entry permits
- Copies of site orientation/briefing documentation and sign-in sheets for new site workers
- Copies of any approved changes to CEHSP
- Copies of the site first aid log if there are new entries for the week
- Listing of man-hours, incidents and incident statistics as requested by the EHS POC.

## 5.5 References

- NREL Laboratory Level Procedure 6-1.51, Construction Environment, Health and Safety
- Title 29 CFR, Part 1910, Occupational Safety and Health Standards
- Title 29 CFR, Part 1926, Safety and Health Regulations for Construction.

## 6 Control of Hazardous Energy, Lockout/Tagout

### 6.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities (i.e., constructing, installing, setting up, adjusting, inspecting, modifying and maintaining/servicing equipment) where the unexpected release of hazardous energy( i.e., electrical, hydraulic, pneumatic, chemical, thermal, compressed gases, mechanical & gravity) or startup of the machines, equipment, and systems could cause injury on NREL Sites.

### 6.2 Regulatory Requirements

The subcontractor control of hazardous energy program and associated work activities as defined in Section 6.1 where the unexpected release of hazardous energy or startup of the machines, equipment, and systems could cause injury shall be conducted in accordance with the following statutory requirements:

- 29CFR1910.147, The Control of Hazardous Energy (Lockout/Tagout)
- 29 CFR 1910.333, Selection and Use of Work Practices
- 29 CFR 1926, Safety and Health Regulations for Construction.

**Exception:** Subcontractors are not required to adhere to requirements for “Periodic Inspections” contained in 29 CFR 1910.147(c)(6).

### 6.3 NREL Specific Requirements/Permits

In addition to Section 6.2, all work activities requiring the use of lockout/tagout shall meet the following NREL requirements as applicable in Sections 6.3.1-6.3.5 of this manual.

#### 6.3.1 Energized Electrical Work

Work on energized systems at NREL must be strenuously avoided unless it is been determined by an appropriate NREL authority that there is no reasonable alternative course of action. If energized electrical work must be performed on hazardous circuits, the subcontractor shall obtain an NREL authorized energized electrical work permit (EEWP) from the project manager prior to performing any energized electrical work. If energized work must be performed on any other type of energy system, it shall be authorized by the NREL Project Manager and EHS POC.

**Exception:** Taking voltage, current measurements and verification of zero energy using standard test equipment such as voltmeters and current probes is permitted on energized electrical systems without an issuance of an EEWP. All other hazard identification, control and PPE requirements to include shock protection and arc flash protection continue to apply and shall be documented in the AHA.

#### 6.3.2 NREL Building Equipment and Systems Lockout/Tagout

Prior to conducting any work which requires lockout/tagout within an existing NREL building or that interfaces with an existing NREL utility system, the subcontractor shall first notify the NREL Project Manager. This includes lockout/tagouts that occur on building construction temporary and/or permanent electrical power tie-ins at the point of NREL supplied power

distribution. The NREL Project Manager shall control, coordinate and approve lockout/tagout work being conducted on these equipment/ systems and shall ensure that the subcontractors are aware of and comply with the requirements of the NREL lockout/tagout program. The Subcontractor shall ensure that the NREL Project Manager is provided with the provisions of the Subcontractor(s) lockout/tagout program/procedures. When NREL equipment/system specific procedures are available, they shall be provided to the subcontractor and utilized as part of the lockout/tagout.

When the subcontractor performs work downstream of the NREL power distribution point for temporary or permanent power tie-in, is downstream of an existing NREL lockout/tagout or is completely independent of existing NREL building equipment/systems, the lockout/tagout shall be performed in accordance with the subcontractor's accepted lockout/tagout program.

#### **6.3.2.1 Tagout Only Requirements**

When equipment/system cannot physically be locked out and a tagout is applied to equipment/system in place of lockout, the subcontractor shall attempt feasible measures to renovate or modify the equipment to accept a lockout device if the energy-isolating device(s). When this cannot be accomplished, the subcontractor shall:

- Implement additional measures to provide the equivalent level of safety (i.e., post an attendant, remove isolating circuit element, valve handle) and document in the AHA and the CSWP.
- Apply a properly completed tag at the energy-isolating device and at the control panel.
- Verify that energy sources are eliminated.
- Check the tag frequently when working under a tagout to verify that it is still in place.

#### **6.3.3 Equipment Specific Lockout/Tagout Procedures**

Written equipment specific procedures are required for complex application or when multiple crews crafts or employers are engaged in a common lockout/tagout application. When written lockout/tagout procedures are required, the subcontractor may elect to utilize their own procedure format or the NREL lockout/tagout equipment specific procedure format. A copy of this format can be obtained by contacting the NREL Project Manager or the EHS Office. If the Subcontractor elects to use their own procedure format then procedures that meet the minimum content requirements of 29 CFR 1910.147 and NFPA 70E will be deemed as acceptable by NREL.

#### **6.3.4 Subcontractor Lockout/Tagout Inspection Procedures**

The subcontractor shall ensure that weekly documented inspections are made for all active lockout/tagout applications. These inspections shall be kept at the jobsite and made available for review by NREL.

The subcontractor shall also perform daily informal (undocumented) inspections to verify lockout/tagouts remain in place.

### **6.3.5 Subcontractor Training Requirements**

Subcontractors that are trained in accordance with the requirements identified in 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout) will be considered as meeting the necessary training requirements for working at NREL. The subcontractor shall provide proof of such training as requested by the EHS POC. The subcontractor is required to provide qualified and competent persons at the job site.

## **6.4 NREL Special Emphasis**

### **6.4.1 Applying Lockout/Tagout**

Each exposed subcontractor worker shall apply their own uniquely keyed lock and a properly completed tag to secure the energy source(s) prior to beginning work activities. When more than one individual is working on the same piece of equipment or project, a group lock box or multi-lock hasps (gang hasp) or other acceptable means shall be used and each worker shall apply his or her lock. Combination locks are not acceptable. Workers shall not rely on another person's lockout for protection. Supervisory controlled lockout/tagouts are prohibited at NREL.

## **6.5 References**

- 29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout)
- 29 CFR 1910.333, Selection and Use of Work Practices
- 29 CFR 1926, Safety and Health Regulations for Construction
- NREL Laboratory Level Procedure, 6-1.55, Lockout/Tagout
- NFPA 70E, Standard for Electrical Safety in the Workplace, Current Revision.

## 7 Electrical Safety

### 7.1 Applicability

The subcontractor shall be responsible for the development and implementation of an electrical safety program to be followed throughout all phases of the construction project and this program shall apply to all Construction Subcontractor and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities performed on NREL Sites unless otherwise specifically exempted by NREL. This program shall be documented.

### 7.2 Regulatory Requirements

The subcontractor electrical safety program shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926, Subpart K, Electrical
- 29 CFR 1910.333, Selection and Use of Work Practices
- 29 CFR 1910.147. The Control of Hazardous Energy (Lockout/Tagout).
- NFPA 70E, Electrical Safety in the Workplace

**Note:** Whenever there is a conflict between any requirements contained or referenced in this chapter, the most stringent requirement shall apply unless specifically exempted by the NREL EHS Office.

### 7.3 NREL Specific Requirements/Permits

In addition to Section 7.2, the subcontractor electrical safety program shall meet the following NREL requirements as applicable.

#### 7.3.1 General Electrical Work Safety Requirements

Subcontractors shall identify the electrical hazards associated within each definable feature of work and establish the controls necessary to maintain an acceptable level of risk. To assist in the evaluation of electrical hazards, subcontractors shall employ an Electrical Risk Assessment consistent with requirements of NFPA 70E, Standard for Electrical Safety in the Workplace (Current Revision as adopted by NREL) for shock and arc flash hazards. The identified hazards and control measures shall be documented in the associated activity hazard analysis (AHA) or other work control document that provides an acceptable level of hazard identification and control for the associated task or work sequence. See Section 4.0, Construction Hazard Identification and Work Control Process for additional information on the AHA process.

The safe electrical work practices that are employed shall prevent electric shock, burns, arc flash or other injuries that could result from either direct or indirect electrical contact. This may include specialized training, observing required approach distances, and the use of appropriate personal protective equipment (PPE) consistent with the requirements of NFPA 70E.

The subcontractor shall conduct electrical job briefings prior to starting work each day. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, PPE requirements, and the information on the

energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of work.

#### **7.3.1.1 Personal Protective Equipment**

Subcontractors are responsible for identifying, providing and maintaining their own PPE. Maintenance of PPE includes the required testing and certification. Records of such testing shall be made available for review.

PPE appropriate to the hazard present shall be used. Electrical PPE may include:

- Rubber insulating gloves
- Eye, face, head and hearing protection
- Non-conductive headgear
- Arc-Flash protective clothing as required by NFPA 70E
- Hot-sticks and similar tools.

#### **7.3.1.2 Qualified Electrical Worker**

Only qualified workers who maintain the necessary skills and knowledge related to the construction, operations of electrical equipment and the associated hazards are permitted to work on electrical systems at NREL. A **“Qualified Electrical Worker”** is a person who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved. Such a person is familiar with the proper use of precautionary techniques, personal protective equipment, insulating and shielding materials, insulated tools, and test equipment in addition NREL specific procedural requirements. Verification of training shall be in accordance with Section 2.3.2.

Apprentice electricians shall work under the supervision of a Journeymen Electrician and shall have received the appropriate electrical safety training prior to assigning work assignments that involve electrical hazards. It is the responsibility of the Journeymen Electrician to assign work that is appropriate for the apprentice's experience, skill level, and training.

NREL doesn't allow apprentice electricians to perform work on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition.

The subcontractor shall be responsible for documenting the qualifications of the “Qualified Electrical Workers” utilized on the project.

#### **7.3.1.3 Ground Fault Circuit Interrupter (GFCI) Protection**

Subcontractors shall ensure that GFCIs are used on 120-volt circuits as specified below:

- In damp or wet (standing water) work areas outdoors
- For temporary power (e.g., extension cords) during construction, remodeling, maintenance, repair or similar activities, outdoor receptacles shall be enclosed with weatherproof (preferably metal) covers



- When using portable, electric hand tools and equipment with cord/plug connectors.

The users of the GFCIs shall test portable GFCIs using the test button provided before each use. If the GFCI breaker fails the test, tag out of service with a “DANGER — DO NOT USE” tag and (if portable) remove from service. Tripped circuit breakers may not be re-energized until it has been determined that the equipment and circuit can be safely re-energized. Do not reset or operate facility circuit breakers. Contact the building area engineer (BAE) or your NREL Project Manager.

#### **7.3.1.4 Flexible Cords and Cables**

Use UL-listed flexible cords suitable for conditions of and location of use. Flexible cord sets used with grounding-type equipment shall contain an equipment grounding conductor. Protect flexible cords and cables from damage. When possible, hang extension cord sets appropriately in the overhead to avoid tripping hazards and damage caused by foot traffic and equipment. Avoid sharp edges, pinching, or improper storage. Cords sets that are damaged shall be removed and discarded or repaired by a qualified person. A **Qualified Person** at NREL is an individual that is familiar with the construction and operation of the equipment and the hazards involved.

#### **7.3.2 Lockout/Tagout**

Subcontractors shall ensure that electrical systems and equipment are effectively isolated, locked, and tagged out in accordance with the requirements of Section 6.0, Control of Hazardous Energy, Lockout/Tagout of this manual prior to performing any work on or near the energized systems. Subcontractors shall make all feasible efforts to effectively isolated and lock and tag out energized electrical systems and equipment in order to avoid performing Hazardous Energized Electrical Work as defined in Section 7.3.3 of this manual.

#### **7.3.3 Hazardous Energized Electrical Work**

Hazardous Energized Electrical Work at NREL is defined as “work performed within the restricted approach boundary or interactions with the equipment when conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc flash hazard exists, on equipment operating at 50 volts or more to ground, or less than 50 volts to ground where the current exceeds 5 mA, creating the potential for injury, explosion or injuries due to electric arcs.”

When it has been determined by the subcontractor in conjunction with the appropriate NREL authorities (NREL Project Manager, Site Operations Electrical Engineer and the EHS Office) that there is no other reasonable alternative course of action, the subcontractor shall obtain an NREL EEWP in accordance with Section 7.3.3.1 from the project manager prior to performing any hazardous energized electrical work.

Controls may still be required for energized work on “non-hazardous circuits” to protect against secondary hazards such as startle or involuntary reactions from contact with low voltage high current sources. These would include circuits operating at 50 volts and less with a short circuit current of greater than 0.5ma or energy greater than 0.25 joules.

*Exception: An EEWP shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE for the following conditions:*

1. *Testing, troubleshooting, and voltage measuring*
2. *Thermography and visual inspections, if the restricted approach boundary is not crossed.*
3. *Access to and egress from an area with energized electrical equipment, if no electrical work is performed and the restricted approach boundary is not crossed.*
4. *General housekeeping and miscellaneous non-electrical tasks, if the restricted approach boundary is not crossed.*

#### **7.3.3.1 Energized Electrical Work Permit (EEWP)**

The subcontractor shall ensure that a permit has been completed with the NREL required concurrences and approvals before work may be initiated on hazardous energized systems. The permit being submitted shall be task specific. Blanket, general, or open-ended permits are prohibited and will not be processed. After a permit has been approved, subsequent changes in the scope of work or associated hazards requires cessation of work and a timely reassessment of this permit. If necessary, additional controls will be established and a new permit issued.

An NREL approved EEWP serves as the authorization basis to conduct energized electrical work on energized circuits.

#### **7.3.4 Two-Worker Rule**

An NREL rule that requires a second qualified electrical worker to be present when work is performed within the shock restricted approach boundary or the arc flash boundary of an exposed energized electrical conductor or circuit part. An example of the work would be zero energy verification and voltage measurement. The second worker functions as a safety observer and does not participate in the actual work. This worker shall be trained in cardiopulmonary resuscitation and be prepared to initiate other emergency response procedures. Subcontractors shall ensure that a second worker is present, as required above.

#### **7.3.5 Safe Penetration of Building Surfaces**

Subcontractors are required to obtain a “NREL Surface Penetration Permit” prior to performing any surface penetration inside existing NREL building and/or facilities. A **Surface Penetration** is defined as an opening made by drilling, cutting, hammering, or otherwise piercing a wall, floor, ceiling, or roof.

The permit outlines the steps necessary for safe penetration of building surfaces such as walls, floors, ceilings, and roofs, specifically with respect to preventing contact with hidden hazards such as live electrical conductors. The NREL Project Manager/BAE will issue the permit to the subcontractor. The subcontractor will be responsible for providing all the required materials, personnel and protective equipment to conduct the surface penetration. These materials may include but not limited to drill stops, GFCIs, dielectric gloves and mats.

**Note:** This permit is also necessary to identify other significant hazards such as natural gas, water lines, and compressed air.

Subcontractors performing surface penetrations in or on new building construction shall be required to utilize an equivalent permit method when the potential exist to contact hidden hazards associated with live electrical conductors, natural gas, water lines, compressed air, etc. A

copy of the NREL Surface Penetration Permit can be obtained by contacting your NREL Project Manager or EHS POC.

### **7.3.6 Excavations**

All excavations including trenching, grading, or drilling activities shall first be permitted by the appropriate NREL BAE or authorized Project Manager. The subcontractor shall adhere to all the applicable electrical safety requirements as provided in Section 8.0.

## **7.4 References**

- 29 CFR 1926, Subpart K, Electrical
- NFPA 70E, Standard for Electrical Safety in the Workplace, Current Revision
- NREL Laboratory-level procedure 6-6.5 Safe Work Permits
- NREL Laboratory-level procedure 6-1.54 Electrical Safety
- NREL Laboratory-level procedure 6-1.63, Safe Penetration of Building Surfaces
- [DOE-HDBK-1092-2013 DOE Electrical Safety Handbook](#).

## 8 Excavations

### 8.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) excavation operations and activities on NREL Sites unless otherwise specifically exempted by the NREL.

### 8.2 Regulatory Requirements

All Subcontractor excavation activities shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926, Subpart P; Excavations

### 8.3 NREL Specific Requirements/Permits

#### 8.3.1 NREL Excavation Permit

In addition to Section 8.2, Subcontractors shall obtain an approved NREL Excavation Permit from the appropriate NREL building area engineer (BAE) or authorized Project Manager for all excavations including trenching, grading, drilling or cutting activities. A copy of this permit system can be obtained from the NREL Project Manager or BAE. **Reference:** NREL Site Operations Project Management Manual, Section 24, Utilities, Attachment 1, Excavating Permit Procedure.

The BAE shall determine what sections of the Excavation Permit need to be satisfactorily completed in order to authorize excavation. At a minimum, the BAE and/or the NREL Project Manager, the Subcontractor Superintendent or designee and equipment operator shall physically walk the proposed excavation site with a site drawing (minimum ANSI C size sheet) and compare to the site utility locate drawing and physical markings. Any deviations identified during this walk shall be resolved prior to issuing the permit.

#### 8.3.1.1 Subcontractor Excavation Plan

The Subcontractor is responsible for submitting to the NREL BAE or authorized Project Manager and EHS an “Excavation Plan” to NREL for review and concurrence before any excavation activity begins. This plan shall show the proposed boundaries on a site map including depth of the affected areas and the safety precautions, which shall comply with OSHA Standard 1926, Subpart P, Excavations. However, where soil tests are required, manual soil tests must include the use of a pocket penetrometer, hand-operated shear vane, or other OSHA approved manual test accepted by NREL. The results of both visual and manual tests must be documented and maintained in a written log by the competent person and shall identify the date, time and location of tests.

The BAE/PM will verify that the Excavation Plan with the appropriate Engineering and Construction "As-Built" utility drawings to identify any potential conflicts with existing underground facilities and/or utility lines, including information provided by the NREL Telecommunications Group.

### **8.3.1.2 Utility Locates**

The NREL Project Manager will dictate the necessary underground location and identification services as part of the Subcontractor's work. In this case, the location service requirements shall be identified in the Subcontractor's excavation plan (Section 8.3.1.1) and shall be performed prior to NREL authorizing the excavation permit. The BAE will verify that the Subcontractor has located and identified all underground services with appropriate color coded markers.

When the Subcontractor is responsible for the underground utility location and identification, public utility locates can be coordinated through the Utility Notification Center of Colorado, 800-9221987. The Notification Center will contact the various utility companies (e.g., Xcel, Consolidated Mutual Water Company, Pleasant view Sanitary Sewer, Qwest) to come to the NREL construction site for the purpose of locating and identifying all underground utilities with the appropriate color-coded markers. Some utility locates on NREL property may require a private utility location company to complete. The NREL Engineering and Construction Office can provide drawings with approximate location of existing utilities and structures to aid in marking the utilities.

If there is any uncertainty as to the degree of safety protection anticipated on underground electrical power lines, the electrical service should be de-energized first with a planned outage arranged and coordinated through the affected BAE and Project Manager.

### **8.3.1.3 Pot Hole Verification**

The NREL Project Manager or assigned representative shall work directly with the Subcontractor who will hand dig or otherwise safely "pot hole" (daylight) to verify location and depth of the various utilities and NREL-owned underground facilities and/or lines which may conflict with the excavation activity.

When the Subcontractor excavating activities are within 5 feet of underground services, the NREL Project Manager or NREL accepted designated representative will be physically present for onsite monitoring to ensure compliance with the NREL accepted plan.

**Note:** At the BAE's discretion, the Subcontractor may perform pothole activities prior to the approval of the Excavation Permit. However, no other excavation may take place without the approved NREL excavation permit.

### **8.3.1.4 Confined Spaces**

When the configuration of an excavation is such that the excavation is deemed to be a confined space, the provisions of the Chapter 16, Confined Space program shall apply.

## **8.3.2 NREL Excavation Lockout/Tagout**

The NREL Project Manager or designated representative will be physically present for onsite monitoring when excavating activities are within 5 feet of underground services to ensure compliance with the approved plan. All underground electrical (50 volts and above) and other systems covered by the lockout/tagout program shall be de-energized and locked out during excavations within 5 feet of those systems unless otherwise approved in advance by the appropriate BAE and EHS POC.

The lockout/tagout shall be in accordance with an NREL accepted Subcontractor Lockout/Tagout Program and the provisions contained in the NREL Site Operations Project Management Manual, Section 24, Utilities, Attachment 2, Site Operations Office Lockout/Tagout Procedure.

During excavation/construction activities, no locks or tags shall be installed or removed on facility systems by Subcontractors without the written approval of the applicable building area engineer (BAE) or designated representative.

### **8.3.3 Subcontractor Training Requirements**

Subcontractor excavation Competent Person(s) that are trained and knowledgeable about soils analysis, the use of protective systems, identification of existing and predictable excavation hazards and the requirements of 29 CFR 1926, Subpart P, Excavations, will be considered as meeting the necessary excavation competent person training for working at NREL. The Subcontractor shall provide proof of such training as requested by the EHS Office. The Subcontractor is required to provide a qualified and competent person at the job site when excavations work is ongoing. The Subcontractor shall ensure that the “Competent Person(s)” can demonstrate that their knowledge and skill-sets match the excavation and protective system(s) that are in place. In addition, all Subcontractors working in or around excavations shall receive general excavation hazards awareness training.

## **8.4 NREL Special Emphasis**

### **8.4.1 Underground Services/Utilities**

A potential hazard on NREL sites is the presence of underground services and structures such as utility lines (water, electric, sewer, gas, or communication), tanks, various gas and liquid process piping, and sewers. If these services or structures are damaged in any way as a result of excavation activities, there may be injury or death to workers, contamination or interruption of services, disruption of processes, and expensive programmatic delays. In order to prevent any incident regarding underground services, ensure all applicable provisions of the NREL Excavation Permit System are adhered to prior to any excavation work at NREL.

### **8.4.2 Munitions and Explosives of Concern**

The laboratory facilities at the South Table Mountain (STM) site are located on a portion of the former Camp George West National Guard base. The former base had a long and varied history as a military installation from 1902 through 1953. Portions of the NREL campus are subject to the discovery of military munitions and explosives of concern (MEC).

All MEC or suspect foreign objects encountered on the STM shall be treated as extremely dangerous. These items can be Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), or Munitions Constituents (MC).

All subcontractors performing work in an “STM identified area of concern” shall brief their workers and lower tier subcontractors on the potential for discovery of MEC and the required response actions. NREL EH&S will assist in providing the necessary information to affected subcontractors on the types of MEC that may be found on the site and required response actions upon discovery.

In the event an employee discovers a MEC or suspect foreign object while performing work on the STM, the employee must be trained to follow the three Rs:

- **RECOGNIZE:** Do not touch, disturb or move the item. Munitions come in all shapes, sizes, and color but exposure to weather and time can alter or remove these markings.
- **RETREAT:** Mark the general location of the MEC with hazard tape, colored cloth or ribbon, hat, etc. at a point no closer than you first recognized it. Do not transmit any radio frequency when in the proximity of an MEC. Evacuate the area to a safe distance of at least 100 yards. Do not allow any co-workers to re-enter the area until it has been cleared by the Jeffco Bomb Squad or NREL Security.
- **REPORT:** Immediately upon reaching a safe distance from the MEC, contact NREL Security at 303-384-6811. Security will notify the Jeffco Bomb Squad.

## 8.5 Subcontractor Responsibilities

The Subcontractor shall be responsible for the following:

- Obtaining an approved NREL Excavation Permit from the BAE
- Monitoring/daily inspections of excavation, trenching and shoring operations
- Designating a Competent Person, who has had the training to act in this position and providing the competent person the authority to effectively discharge their duties
- Ensuring the requirements of this section are effectively communicated and enforced to lower tier sub-contractors
- Investigate and report to the NREL Project Manager all incidents involving excavations, trenching and shoring.

## 8.6 References

- 29 CFR 1926, Subpart P, Excavations
- NREL Site Operations Project Management Manual, Section 24, Utilities, Attachment, Excavating Permit Procedure. Revision 0, March 31, 2012
- NREL Site Operations Project Management Manual, Section 24, Utilities, Attachment 2, Site Operations Office Lockout/Tagout Procedure. Revision 0, March 31, 2012.



## 9 Fire Protection and Prevention

### 9.1 Applicability

The subcontractor shall be responsible for the development and implementation of a fire protection program to be followed throughout all phases of the construction project and this program shall apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities performed on NREL Sites unless otherwise specifically exempted by NREL.

### 9.2 Regulatory Requirements

The subcontractor fire protection & prevention program shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926.24, Fire Protection & Prevention
- 29 CFR 1926, Subpart F, Fire Protection & Prevention
- 29 CFR 1926, Subpart J, Welding & Cutting.

### 9.3 NREL Specific Requirements/Permits

In addition to Section 9.2 of this manual, the subcontractor fire protection and prevention program shall meet the following NREL requirements as applicable.

#### 9.3.1 *Working with Open Flame, Welding, Cutting, or Grinding*

The following requirements apply to Subcontractors conducting activities with open flames, welding, cutting, or grinding and other flame/spark producing tasks (hereafter referred to as “Hot Work”).

- The subcontractor shall perform Hot Work in accordance with a Hot Work Permit System as outlined in section 9.3.2 of this manual.
- The subcontractor shall ensure that all lower-tier subcontractors understand and comply with the requirements of the permit system.
- Subcontractor personnel who perform fire watch duties shall be qualified. Individual(s) performing fire watch duties shall be proficient in the use of fire extinguishers.
- Alternatives to performing hot work (e.g., saw cutting instead of grinding wheel or torch cutting; crimp-type pipe fittings instead of soldered fittings) should be used where practical.
- Hot work should be performed in subcontractor shops or designated areas (e.g., pre-approved weld booths or shop areas) where practical.
- The subcontractor shall ensure that hot work is not conducted during facility fire-sprinkler system outages.
- Completed hot work permits shall be returned to the Project Manager/BAE and/or Construction Subcontractor Safety Officer as applicable when the work is complete.



### **9.3.2 Hot Work Permit System**

Subcontractors conducting hot work will either perform the hot work under the NREL Hot Work Permit System or will be allowed to utilize their own permit system after review and acceptance by the NREL EHS Office. NREL EHS may choose to observe the subcontractors hot work permit system until such time that NREL is comfortable that all performance expectations are being met. All hot work performed inside of existing NREL buildings shall be performed under the NREL Hot Work Permit System. The NREL Project Manager/BAE or the EHS Office will issue the permit. The subcontractor will be responsible for providing all the required materials, personnel and protective equipment to conduct all hot work.

Prior to the start of any hot work activity, the subcontractor shall perform a walk-down of the work to facilitate thorough hazard identification and control. The subcontractor is ultimately responsible for compliance with the requirements of the permit. The Hot Work Permit is valid for the specified task noted on the permit and may not exceed 30 days in duration. Variance from the scope of work identified on the permit is prohibited.

The NREL Hot Work Permit System and the associated Hot Work Permit Checklist can be obtained from the NREL EHS Office.

#### **9.3.2.1 Hot Work Location Selection Hierarchy**

The location of hot work shall be determined by utilizing the following priority list:

- If work must be conducted onsite, combustibles shall not be located within 35 feet of the work area.
- If work must be conducted onsite and combustibles cannot be removed from within 35 feet of the work area, fire barriers such as screens or blankets shall be used to protect combustibles.
- Protect openings in walls, floors, roofs, and ceilings where sparks can travel beyond the work area to inaccessible or unprotected areas. Openings or cracks in walls, floors, roofs or ceilings within 11 m (35 ft) of the site shall be tightly covered with fire-retardant or noncombustible material to prevent the passage of sparks to adjacent areas.
- Beware of heat conduction through penetrations. Hot work that is performed on pipes or other metal that is in contact with combustible walls, partitions, ceilings, roofs, or other combustibles, shall not be undertaken if the work is close enough to cause ignition by conduction.

#### **9.3.2.2 Fire Watch**

The subcontractor shall establish a fire watch to protect the safety of workers and assets. The fire watch observes staff conducting the welding, cutting, or grinding operations and monitors adjacent areas. The worker assigned to this task of fire watch shall have fire extinguishing equipment readily/immediately available.

The fire watch shall observe the hot work area for 30 minutes (60 minutes for roof work) after the completion of hot work. For overhead work, a fire watch may be necessary on multiple levels. The fire watch may not be assigned any other duties during hot work operations. The fire

watch shall stop work if sparks travel beyond the area that fire watch can observe. Individuals assigned to fire watch duties shall:

- Be qualified and understand the requirements of the hot work permit system.
- Be knowledgeable about fire and emergency reporting procedures to the CMS and fire alarm pull box locations in buildings, if applicable.
- Have emergency communications, such as cellular phones or radios, available when working in remote or outside areas.
- Be trained in the use of fire extinguishing equipment.
- Prior to leaving the site, the fire watcher shall verify that the possibility of fire does not exist.

#### **9.3.2.3 Fire Protection Equipment**

Fire protection equipment shall be sufficient for the hazards present. At a minimum, a 4A:60BC rated fire extinguisher is required. The fire extinguisher shall be readily available in the immediate work area. Free access shall be maintained at all times to all exits, fire alarm boxes, fire extinguishing equipment, and any other emergency equipment. Free access means clear of all obstructions.

#### **9.3.2.4 Hot Work Protective Clothing**

Subcontractors shall ensure that the personnel protective clothing selected for hot work minimizes the potential for ignition, burning, trapping hot sparks and electric shock as identified in ANSI Z49.1, "Safety in Welding, Cutting and Allied Processes," sections 4.3 and E4.3, current revision.

#### **9.3.2.5 Hot Work Required Inspections.**

In addition to the fire watch requirements, the subcontractor's authorized worker/permit holder shall inspect the work area a minimum of once per day to verify compliance with permit requirements. Additionally, responsible subcontractor personnel shall also perform periodic inspections to ensure continued compliance with the requirements of the permit. When inspections identify unsafe conditions or the scope of work departs from that defined in the permit, the hot work shall be stopped immediately.

#### **9.3.2.6 Hot Work Outdoors**

The subcontractor shall ensure that vegetation and other combustibles are removed, cut back, or otherwise protected to prevent ignition during hot work outdoors. A high level of caution shall be exercised to prevent wild land fire. If wind speeds exceed a constant velocity of 10 miles per hour, hot work is not permitted outdoors.

### **9.3.3 Fire Protection System Outages and Impairments**

Subcontractors performing work shall plan their work and take the necessary steps to minimize outages or impairments of fire suppression, detection, or alarm systems. When outages are necessary to perform a particular scope of work, they shall be coordinated and approved by the NREL Project Manager and the EHS Office. A NREL Fire Protection System Outage Permit

shall be issued by the NREL Project Manager/BAE. Compensatory measures necessary to achieve a commensurate level of fire protection shall be incorporated into the permit.

#### **9.3.4 Exits and Exits Access**

The subcontractor shall ensure that a clear path of at least 44 inches is maintained to exits on indoor projects. Exits shall be marked by a readily visible sign. Access to exits shall be marked by readily visible signs in all cases where the exit or way to reach it is not immediately visible to the occupants.

#### **9.3.5 Flammable and Combustible Liquids Storage**

Flammable and combustible liquids shall be stored in approved containers and cabinets, such as those that are UL or FM listed, and quantities shall be limited to minimize fuel loading in accordance with NFPA Codes. Rags used to apply flammable liquids are to be disposed of in a self-closing approved safety containers designed for that use.

#### **9.3.6 Smoking/Wildfire**

Smoking, if permitted by the subcontractor, shall be restricted to NREL designated areas that incorporate appropriate facilities for the safe disposal of smoking materials. Due process and control shall be employed to prevent wildfire. Open fires are prohibited.

#### **9.3.7 Housekeeping/Trash**

The subcontractor shall police the work area frequently and maintain good housekeeping. Common garbage and other waste shall be disposed of at frequent and regular intervals. Containers shall be provided for the collection and separation of waste, trash, oily or used rags, and other refuse. Containers used for garbage and other oily, flammable, or hazardous wastes, (such as caustics, acids, harmful dusts or similar materials) shall be equipped with covers. Chemical agents or substances, which might react to create a hazardous condition, shall be stored and disposed of separately.

#### **9.3.8 Portable Electric Heaters**

The following requirements apply to portable electric heaters used on the jobsite:

- Portable electric heaters shall be equipped with a tip-over switch.
- Locate portable electric heaters in areas that minimize their fire hazards.
- Do not use portable electric heaters near flammable materials/liquids.
- Follow manufacturer's literature for clearance of listed portable electric heaters from combustible materials.
- Never place portable electric heaters on an unstable surface.
- Use only portable electric heaters approved by Underwriters Laboratories, Inc. (UL) or another nationally recognized test laboratory (NRTL).
- Portable electric heaters shall not be used with extension cords, as most extension cords are not rated for the higher power demands of space heaters and may become overloaded and catch fire.

## 9.4 References

- 29 CFR1926.24, Fire Protection & Prevention
- 29 CFR 1926, Subpart F, Fire Protection & Prevention
- 29 CFR 1926, Subpart K, Welding & Cutting
- NREL Laboratory-level procedure 6-6.5 Safe Work Permits.
- NREL Laboratory-level procedure 6-1.36 Fire Protection.
- ANSI Z49.1, “Safety in Welding, Cutting and Allied Processes,” Sections 4.3 and E4.3, current revision.

## 10 Hoisting and Rigging

### 10.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) hoisting and rigging (H&R) activities on NREL Sites unless otherwise specifically exempted by the NREL.

The equipment covered under this procedure includes H&R devices and associated equipment such as slings, ropes, and chains, which provide mechanical assistance in raising and lowering a load. This includes either power or manually operated equipment.

### 10.2 Regulatory Requirements

All Subcontractor H&R activities shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926, Subpart CC, Cranes and Derricks in Construction
- Rigging of loads being lifted by cranes shall comply with the requirements of 29 CFR 1926.251, Rigging Equipment for Material Handling
- Hoisting and Rigging during steel erection activities shall comply with the requirements of 29 CFR 1926.753, Hoisting & Rigging.

**Exception:** This section does not include requirements for powered industrial trucks (PIT).

### 10.3 NREL Specific Requirements/Permits

In addition to Section 10.2, all Subcontractor hoisting and rigging (H&R) activities shall meet the following specific NREL requirements as applicable.

Subcontractors bringing H&R equipment on site shall be able to demonstrate that their equipment is properly maintained, in safe operating condition, and that operators are experienced and qualified. Subcontractor crane operators are not permitted to operate NREL H&R equipment. All H&R equipment brought on site shall be in a new or like new condition free of hydraulic or oil leaks.

#### 10.3.1 Operator Training and Certification

Subcontractors who provide and operate H&R equipment, as part of a construction project or similar activity, shall provide:

- **Proof of Training/Certification:** NREL requires proof of training, such as an NCCCO license or other NREL accepted licenses/certification. NREL recognizes the NCCCO national certification program as demonstrating that the certified H&R operator meets OSHA’s and NREL’s requirements for crane operator proficiency. This certification/license shall be current for the crane type they will be operating. (i.e., Mobile Crane Operator, Tower Crane Operator) Any other forms of crane certification must be accepted by the NREL POC.

- **Medical Requirements:** Crane operators shall complete a medical certification examination at least every three years in accordance with ASME B.30.5. A valid medical card shall be provided to document this requirement.

### **10.3.2 Hoisting and Rigging Operating Requirements**

#### **10.3.2.1 Planning**

The subcontractor shall evaluate and plan H&R operations in advance. A competent person shall identify the hazards and determine the controls necessary to maintain an acceptable level of risk. A Hoisting and Rigging Lift Plan is required for complex and critical lifts. This plan shall be documented using the NREL Hoisting and Rigging Lift Plan or similar plan accepted by NREL.

#### **10.3.2.2 Critical and Complex Lifts**

The subcontractor shall utilize the NREL Hoisting and Rigging Lift Plan or other NREL accepted equivalent plan to document critical and complex lifts. The NREL Hoisting and Rigging Lift Plan template can be obtained from the EHS Office. All critical and/or complex lift plans require the review and concurrence of the NREL Project Manager and EHS POC.

**Critical lifts** are defined as lifts for which any of the following conditions exist:

- The weight of the load is 90 percent or more of the crane's rated capacity in the configuration that will be used during the lift.

**Exception:** During steel erection, a critical lift is defined as a lift that exceeds 75 percent of the crane's rated capacity or requires the use of more than one crane.

- Lifts involving non-routine or difficult rigging arrangements or where loads will require exceptional care in handling because of size, weight, close-tolerance installation or high susceptibility to damage.
- Hoisting of personnel with a crane or derrick.
- If the item being lifted were to be damaged or upset, it could result in a release of hazardous material into the environment or the release of airborne concentrations that could exceed established occupational exposure limits.
- The item being lifted is unique and, if damaged, would be irreplaceable or not repairable and is vital to a system, facility, or project operation.
- The cost to replace or repair the item being lifted, or the delay in operations of having the item damaged, would have a negative impact on the facility, organization, or construction project to the extent that it would affect project commitments.
- The item, although non-critical, is to be lifted above or in close proximity to a critical item or component.

**Complex Lifts** are defined as lifts that present logistical difficulties or lift coordination complications, thus requiring a higher level of planning and execution. Complex lifts may involve the following:

- A lift involving multiple cranes

- Axial rotation of an object in the vertical plane or other complex movement of the load
- A lift where the behavior of the load while in suspension is questionable.

#### **10.3.2.3**      *Pre-Lift Meeting*

Prior to performing any lift, the subcontractor shall conduct a pre-lift meeting with workers involved in the work activity. The following items shall be reviewed:

- The scope and sequence of work
- Roles and responsibilities
- Hazards and controls
- Other relevant information identified in the Hoisting and Rigging Lift Plan.

When performing lifts designated as critical and/or complex lifts, this meeting shall be documented utilizing the NREL Pre-Lift Meeting Checklist or other equivalent NREL EHS accepted checklist. A copy of the NREL Pre-Lift Meeting Checklist template can be obtained from the EHS Office.

#### **10.3.2.4**      *Communication*

The subcontractor shall require the use of ANSI B30.5 standard hand signals or voice/radio communications during the course of crane operations.

#### **10.3.2.5**      *Area Access Control*

The subcontractor shall cordon off or manually control the lift area to prevent access by unauthorized workers by deploying barricades and warning signs and/or utilizing personnel to monitor and control access to the area. The subcontractor shall cordon off the swing radius area for mobile cranes with warning tape or other barricade apparatus, such as cones.

#### **10.3.2.6**      *Protection of People*

Do not place people in jeopardy by moving a suspended load over people or an occupied section of a facility. Work beneath a suspended load is prohibited unless the load is supported by cribbing, jacks, or a solid footing that safely supports the entire weight. All personnel shall remain clear of moving and shifting loads.

#### **10.3.2.7**      *Rated Load Capacity*

The rated load capacity of monorails and other H&R structural elements, such as jibs, shall match, at a minimum, the rated load capacity of a hoist placed upon it.

Know the weight of the object being lifted or use a dynamometer or load cell to determine the weight. If the weight of the load is unknown, a minimum 50% safety factor shall be employed. This means that the crane or hoist, slings, and rigging hardware shall have twice the capacity of the estimated load.

Fully extend outriggers or reduce the cranes rated load capacity as directed and allowed by the crane manufacturers operating manual.

#### **10.3.2.8      *Electrical Distribution Lines***

Watch for overhead electrical distribution and transmission lines and maintain a safe working clearance of at least 10 feet or as required from energized electrical lines. Any overhead wire shall be considered to be an energized line unless and until the NREL Electrical Engineer or the electrical utility authorities indicate that it is not an energized line. Exercise caution when working near overhead lines having long spans as they tend to move laterally or vertically due to the wind, which could cause them to breach the safety zone.

#### **10.3.3 *Environmental Factors***

Environmental factors, such as weather and terrain can adversely affect a lift. When performing outdoor lifts, the following environmental factors shall be considered:

##### **10.3.3.1      *High Winds***

Lifts shall be suspended if prevailing wind conditions may adversely affect the lift. As a general rule, this applies to wind speeds of 25 miles per hour or more. However, based on the nature of the load—such as size, surface area, or fragility—a lower wind speed limit may warrant suspension of a lift. The H&R operator and/or lift master shall evaluate behavior of the load in prevailing winds and the stresses placed upon H&R equipment to the extent necessary to safely complete the lift.

##### **10.3.3.2      *Freezing Surfaces***

Check surface conditions to determine if the load may be frozen to the ground. Do not use H&R equipment to “break loose” a load that is frozen to the ground. This subjects H&R equipment to severe and unintended loads.

##### **10.3.3.3      *Ground Conditions***

Check ground conditions around the hoisting equipment for proper support, including settling under and around outriggers, ground water accumulation or other similar conditions.

#### **10.3.4 *Crane Inspection, Maintenance, and Testing***

##### **10.3.4.1      *Crane Initial Inspection***

Prior to being placed into service, all Subcontractor-owned and/or rented cranes shall undergo an initial inspection. The NREL Subcontractor Crane Inspection Checklist or equivalent accepted checklist shall be utilized to document these inspections. When qualified third party inspections are performed to meet the requirements of this inspection, a copy of the third party inspection shall be attached to the Subcontractor Crane Inspection Checklist which will satisfy the crane physical inspection portion of the checklist. The NREL Subcontractor Crane Inspection Checklist template can be obtained from the EHS Office. NREL EHS may elect to oversee the subcontractor’s initial inspection of the crane.

All crane inspection deficiencies shall be identified and documented and the safety implications shall be determined. The subcontractor shall maintain the original copy of the inspection report and provide a copy to the NREL Project Manager and EHS. The crane owner shall take immediate action to correct the identified deficiencies.



- **Mobile Boom Cranes:** For wheel mounted or crawler type boom cranes, the Subcontractor competent person shall inspect the crane. The subcontractor may elect to utilize a qualified independent third-party inspector to meet this requirement.
- **Lattice Boom or Tower Cranes:** Lattice boom and tower cranes require a thorough inspection prior to being placed into service on NREL property. If the Subcontractor is utilizing a lattice boom or tower crane, the crane shall undergo a thorough initial inspection prior to the start of work by a qualified independent third-party inspector. The subcontractor shall bear the expense of this inspection.

#### **10.3.4.2      *Daily Pre-Operational Inspections***

H&R operators shall visually inspect the following items each day or prior to first use if the hoist has not been in regular service. Records are required.

- Functional operating mechanisms for maladjustment interfering with proper operation
- Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air systems
- Hooks for cracks, deformation, latch engagement, and damage from chemicals
- Hoist rope for significant wear, kinking, crushing, bird-caging, corrosion, or broken strands or wires
- Hoist chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations
- Primary hoist upper-limit device for proper operation.

Deficiencies: H&R operators or other designated qualified workers shall examine deficiencies and determine whether the equipment should be removed from service or if a more detailed inspection is required.

#### **10.3.4.3      *Monthly Inspections***

Cranes active on the site for periods extending beyond 1 month shall receive monthly documented inspections. The competent person shall at a minimum visually inspect the following items for damage, wear, or other deficiency that might reduce capacity or adversely affect the safety of the crane.

- Critical items such as brakes and crane hooks
- Hoist ropes.

Signed and dated inspection records shall be kept on file and shall be readily available. Before the crane is returned to service, correct deficiencies that could reduce its capacity or adversely affect its safety.

#### **10.3.4.4      *Annual Inspections***

Annual crane inspections shall conform to the requirements identified in 29CFR1926, Subpart N and as recommended by the manufacturer. Documentation of these inspections shall be available for review by NREL.

#### **10.3.4.5**      *Idle Equipment*

H&R equipment that is idle for a period of greater than one month (fully operational but not used) does not require monthly inspections. Idle H&R equipment shall be removed from service and tagged with an administrative “CAUTION – Do Not Operate” label to alert potential users of the start-up inspection requirements to include the requirements contained in the daily and monthly inspections. Documentation of these inspections shall be available for review by NREL.

#### **10.3.4.6**      *Maintenance*

A preventive maintenance program shall be established and based on the recommendation of the crane manufacturer. If equipment maintenance procedures deviate from published manufacturer's recommendations, the alternate procedures shall be approved in advance by the manufacturer or another qualified person and be kept readily available. Dated maintenance records should be kept readily available to appointed personnel. Replacement parts shall be at least equal to the original manufacturer's specifications.

#### **10.3.4.7**      *Rated Load Test*

Prior to initial use, all cranes in which load sustaining parts have been modified, replaced, or repaired shall be load-tested by a qualified inspector or under the direction of that inspector. All rated load tests shall be performed in accordance with manufacturer's recommendations.

### **10.3.5 Rigging Safety Requirements**

#### **10.3.5.1**      *Rigging Component Procurement*

Rigging components shall be obtained from reliable sources and shall be rated for H&R applications. Do not use damaged or suspect rigging. Chinese shackles are not permitted to be used. See section 10.4.2 for additional information on suspect and counterfeit rigging and hoisting requirements.

#### **10.3.5.2**      *Storage and Maintenance*

Rigging equipment shall be stored and maintained in accordance with the manufacturer's recommendations. Protect rigging hardware from weathering and harsh environments. Rust, corrosion, and/or UV damage can degrade rigging performance.

#### **10.3.5.3**      *Labeling*

Rigging hardware shall be labeled for identification purposes with a durable tag.

#### **10.3.5.4**      *Rigging Safe Work Practices*

The subcontractor shall ensure that the following safe work practices are utilized when rigging a load:

- Determine the weight of the load. Do not guess. The weight of the load shall be within the rated load capacity of the rigging.
- Determine the proper size for slings and components. Refer to the manufacturer's literature and the DOE Hoisting and Rigging Standard for details.

- Select slings so that the rated load capacity is adequate when the appropriate de-ratings are applied based on sling angle and/or hitch angle considerations (chocker angle de-rating).
- Verify that shouldered eyebolts are installed in accordance with the manufacturer's recommendations. Beware of side pull applications. Eyebolts shall be de-rated when subject to side loads.
- Do not use shoulder less eyebolts for lifting purposes.
- Use safety hoist rings (swivel eyes) as a preferred substitute for eyebolts when possible.
- Pad sharp and small diameter edges to protect slings. Machinery foundations or angle-iron edges may not feel sharp to the touch but could cut into rigging when under load. Dense foam, tire rubber, or other dense, pliable materials may be suitable for padding.
- Do not use slings, eyebolts, shackles, hooks, or other hardware that appear to have been cut, welded, brazed, or is otherwise suspect.
- Determine the center of gravity and balance the load before moving it. Keep the attachment points of rigging accessories as far above the center of gravity as possible.
- Lift the load initially just a few inches to test the rigging and balance.
- Place blocks beneath loads prior to setting down the load to allow removal of the sling, where applicable.

### **10.3.6 Inspection Criteria for Slings, Below-the-Hook Lifting Devices and Rigging Hardware**

#### **10.3.6.1 Prior to Use Inspection**

At the beginning of each shift or prior to use, if it has not been in regular service, the competent person shall visually inspect the rigging equipment (slings, below the hook devices and rigging hardware) in accordance with the appropriate ASME/ANSI standard or according to the manufacturer's instruction, whichever is more stringent. Defective rigging equipment shall be removed from service and destroyed to prevent reuse.

#### **10.3.6.2 Periodic Inspections**

Rigging equipment shall be inspected periodically in accordance with the appropriate ASME/ANSI standard or according to the manufacturer's instruction, whichever is more stringent. This inspection shall be performed by a qualified inspector and have a documented inspection history, with records readily available.

### **10.3.7 Personnel Hoisting**

#### **10.3.7.1 Personnel Platform Lift Plan**

The use of H&R equipment to hoist workers onto a platform is generally prohibited, except when the use of a conventional means of reaching the work area, such as a ladder, scaffold, or man lift, would be more hazardous or is not possible because of structural design or worksite conditions. Personnel lifts shall be properly planned and executed. The NREL EHS Office shall authorize this type of activity in advance of the lift. The NREL Personnel Platform Lift Plan or other

NREL EHS accepted equivalent plan shall be utilized to document these lifts. The NREL Personnel Platform Lift Plan template can be obtained from the EHS Office.

#### **10.3.7.2 Pre-Lift Meeting**

A pre-lift meeting shall be conducted prior to initiating a personnel lift. Workers involved in the work activity shall attend the pre-lift meeting, including subcontractors, man basket occupants, and the H&R operator.

### **10.4 NREL Special Emphasis**

#### **10.4.1 Department of Energy Hoisting and Rigging Standard**

NREL adheres to the Department of Energy (DOE) Hoisting and Rigging Standard as a best management practice. The Hoisting and Rigging Standard is a DOE-wide consensus standard for rigging, crane, and hoist operations. It references applicable industry standards and regulations governing this type of work. The Hoisting and Rigging Standard contains detailed information on H&R inspection, testing, maintenance, and operational requirements.

#### **10.4.2 Suspect and Counterfeit(S/CI) Rigging and Hoisting Components**

Per the DOE standard, shackles must meet or exceed the requirements of Federal Standard RR-C-271D. Each shackle body must be permanently and legibly marked in raised or stamped letters on the side of the bow and must be used to show:

- Manufacturer's name or trademark
- Size
- Safe working load or working load limit.

The American Society for Testing and Materials standard for hooks requires that the manufacturer's identification be forged, cast, or die-stamped on a low-stress or non-wearing area of the hook.

The following are some indicators of S/CI hoisting and rigging components such as shackles, wire rope clips, slings, or hooks:

- Metallurgy is suspect.
- Original markings have been ground off and re-stamped.
- Identification tags have altered markings.
- Item appears used.
- Parts are identified only as "China," "Korea," "Mexico," "Thailand," or "India."
- Documentation does not exist or is incomplete.
- Red hooks are not labeled with Crosby Group markings ("Crosby" or "CG").

**Note:** All Chinese shackles are prohibited from being used on the NREL site.

## 10.5References

- 29 CFR 1926, Subpart N, Cranes and Derricks
- NREL Laboratory Level Procedure, Hoisting & Rigging, 6-1.56
- DOE-STD-1090-2007; Hoisting and Rigging Standard
- ASME B30.5, Mobile and Locomotive Cranes - 2007
- ASME B30.9, Slings - 2006
- ASME B30.10, Hooks - 2005
- ASME B30.20,Below-the-Hook Lifting Devices - 2006
- ASME B30.26, Rigging Hardware - 2004.

# 11 Fall Protection

## 11.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities which require personnel to work or potentially be exposed to unprotected heights of six feet or more on NREL Sites unless otherwise specifically exempted by NREL. This includes working at unprotected heights of six foot or more cause by excavation and trenching activities.

## 11.2 Regulatory Requirements

The subcontractor fall protection program shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926, Subpart M: Fall Protection
- Fall protection during steel erection activities shall also comply with the requirements of 29 CFR 1926.760(a)(2), perimeter safety cable and 1926.76(e), custody of fall protection.

**Note:** The increased height allowances, for unprotected workers, provided in Steel Erection (29 CFR 1926.760) and Scaffold Activities (29 CFR 1926.451) do not apply at NREL.

Additionally, all workers who are constructing a leading edge 6 feet or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems. No exceptions allowed.

## 11.3 NREL Specific Requirements/Permits

In addition to Section 11.2, all work activities and/or potential personnel exposures to unprotected heights of six feet or more shall meet the following NREL requirements as applicable in Sections 11.3.1-11.3.4 of this manual.

### 11.3.1 Fall Protection Program

Subcontractors providing services to NREL that meet the applicability as defined in Section 11.1 shall have in place a Fall Protection Program that ensures effective fall protection system(s) are in place anytime workers are exposed to falls at heights of six feet or more. The program shall identify the following key personnel as identified in ANSI Z359.2 who maintain the requisite knowledge and responsibility for the successful implementation of the program at the project:

- Program Administrator
- Qualified Person
- Competent Person.

Additionally, the subcontractor shall ensure personnel that are required to utilize fall protection meet the qualification of an “Authorized Person” as defined by ANSI Z359.2.

**Note:** Employees trained by a competent person in accordance with the requirements identified in 29 CFR 1926.503, Fall Protection Training Requirements will be considered as meeting the necessary fall protection training for an “Authorized Worker.”

The subcontractors fall protection program shall contain a Site Specific Fall Protection Plan that outlines how the subcontractor intends to comply with the requirements of this chapter. The requirements for the plan are outlined in Section 11.3.1.1.

#### **11.3.1.1**      *Fall Protection Plan*

Subcontractors shall develop and submit a fall protection plan as part of the site specific Construction EH&S Plan. The plan shall be prepared by a qualified person or competent person for the subcontractor and developed specifically for the activity and/or project where the work will occur. The FPP shall be documented and contain the following elements at a minimum:

- Project/Job location/date(s)
- Project/Job description
- Name of the Subcontractor Fall Protection Program Administrator, Qualified Person and the Competent Person(s) responsible for fall protection on this site/project
- Provide verification of training certification for personnel affected by the fall protection plan
- Signature of the competent person preparing the plan and the Subcontractor Site Safety Representative
- Document how the requirements of this plan will be flowed down to lower-tier subcontractors
- Fall hazard analysis(s) (FHA) conducted in accordance with Section 11.3.1.2 for each activity or similar activity type/grouping associated with the project.

#### **11.3.1.2**      *Fall Hazard Analysis*

A fall hazard analysis (FHA) shall be conducted for each activity or similar activity type/grouping prior to the start of the work activity and shall be included in the FPP or as part of the activity hazard analysis (AHA) for the subject activity and/or definable feature of work. The FHA shall be performed by a competent person and/or qualified person. This analysis shall identify one or more methods to eliminate or mitigate fall hazards. The analysis shall be comprehensive, thorough, and address the following elements:

- Identify the fall hazards associated with the proposed activity.
- Identify the controls that will be in place to eliminate or mitigate the fall hazard. The controls shall achieve 100% continuous fall protection. The selection of controls shall be in accordance with Section 11.3.1.3, Fall Protection Hierarchy of Control and Mitigation Methods
- When utilizing a personal fall arrest system (PFAS), identify the means to be utilized for the prompt rescue of employees in the event of a fall.

The subcontractor may perform this analysis by using the NREL Fall Hazard Analysis form or this analysis may be conducted and included as part of the AHA prepared for the subject project/activity. A copy of the NREL Fall Hazard Analysis form can be obtained from the NREL EHS Office.

#### **11.3.1.3**      *Fall Protection Hierarchy of Control and Mitigation Methods*

The subcontractor shall incorporate the following hierarchy of control when selecting methods to eliminate or mitigate fall hazards:

- **Hazard Elimination.** First consider eliminating fall hazards. This might involve moving the work surface to ground level or changing a task so that workers do not approach the fall hazard.
- **Passive Fall Protection.** Take actions that isolate or effectively separate the hazard from workers, such as installing floor coverings or handrail/guardrail systems.
- **Fall Restraint.** Establish a travel restraint system that prevents a worker from accessing a position from which he or she could fall.
- **Fall Arrest.** Configure a PFAS designed to arrest a fall after it has begun.
- **Administrative Fall Protection System.** Establish controlled-access zones and safety-monitoring systems. Generally these controls are considered ineffective and are prohibited at NREL, unless specifically authorized by the EHS Office.

#### **11.3.2** *Fall Protection Equipment System Requirements*

Fall protection equipment and systems shall be used in accordance with the manufacturer's recommendations and the requirements of this procedure. Misapplication or use of this equipment in a way contrary to those requirements is prohibited. A competent person shall supervise the work and verify that the fall protection system is properly established and maintained.

##### **11.3.2.1**      *Personal Fall Arrest System Strength Requirements*

Subcontractors shall ensure that the strength and testing requirements for personal fall arrest systems, components and subsystems shall comply with the provisions of ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components. All other applicable fall protection equipment and system requirements shall at a minimum meet the requirements of ANSI A10.32 Standard for Personal Fall Protection used in Construction and Demolition Operations.

##### **11.3.2.2**      *Personal Fall Arrest System (PFAS) Inspections & Storage*

**Routine Inspection.** PFAS equipment shall be inspected by the authorized worker using the equipment prior to each use. Equipment inspections shall follow the guidelines established by the manufacturer. Damaged or questionable equipment shall be immediately removed from service and tagged accordingly. Equipment that cannot be repaired shall be destroyed.

**Post-Fall Inspection.** PFAS components subject to a fall shall be immediately removed from service and destroyed or returned to the manufacturer for inspection, repair, and re-certification. Contact the manufacturer to determine the available options.



**Periodic Inspection.** A competent person, other than the user, shall periodically inspect PFAS equipment. This inspection shall follow the intervals and guidelines established by the manufacturer but shall not be greater than six months. The results of these inspections shall be recorded and available for review by NREL.

**Equipment Storage.** Fall protection equipment shall be stored in a manner that protects it from exposure to adverse conditions, such as ultraviolet light or harsh weather, that could result in damage or diminished performance and/or other specific requirements established by the manufacturer.

#### **11.3.2.3      *Anchorage***

The application and use of all fall protection anchorages (certified or non-certified) must be reviewed and accepted by a qualified person. The design, selection and installation of certified fall arrest anchorages shall be performed under the supervision of a qualified person. Anchorages used for horizontal lifeline systems shall be certified, and designed, prior to use, by a qualified person with experience and training in designing and using horizontal lifeline systems.

#### **11.3.2.4      *Horizontal Lifelines***

The adequacy of the fall protection system shall be demonstrated through evaluation by a qualified person or by test force. Unless otherwise specified, newly installed horizontal lifelines shall be either pre-engineered systems or systems approved by a professional engineer.

#### **11.3.2.5      *Safety Net Systems***

The use of safety net systems as the means of fall protection is not anticipated at NREL unless used in conjunction with other accepted means of fall protection and compliance with other regulatory requirements (i.e., 29 CFR 1926, Subpart R, Steel Erection). Contact the NREL EHS Office for additional information on safety net systems.

#### **11.3.2.6      *Portable Ladders***

##### **General Requirements:**

- Portable ladders shall be set up and used in accordance with Occupational Safety and Health Administration (OSHA) and manufacturer requirements and be a minimum Type I, Heavy Duty Classification. Light and medium duty class ladders are prohibited.
- Extension ladders shall be tied/secured off to prevent displacement.
- Ladder users shall maintain three-point control (three limbs maintain contact on the ladder) while ascending and descending the ladder,
- Job made ladders when constructed and used must be built in accordance with the American National Standards Institute (ANSI) A14.1-1982 - American National Standard for Ladders-Portable Wood-Safety Requirements. Job made ladders shall receive daily visual prior to use and weekly documented inspections. Otherwise, portable wooden ladders are prohibited from use.

##### **Fall Protection – Portable Ladder Exception:**

Fall protection is not required when using portable ladders in accordance with the following requirements.

- The ladder user is ascending or descending a portable ladder of twenty-four (24) feet or less in height, while maintaining three points of contact, with their body position centered between the ladder rails. The ladder is not positioned next to an opening or edge, thus exposing the user to an increased fall hazard (greater than the distance to the base of the ladder); and the users elevated position does not expose them to other hazards (including impalement, mechanical, electrical, chemical or environmental).
- The ladder work activity has been evaluated by a competent person who has made the determination that the work activity meets all of the requirements of this section. Otherwise, a personnel lift shall be utilized or fall protection shall be evaluated for feasibility.

#### **11.3.2.7      *Aerial Lifts, Scissor Lifts and Elevating Aerial (Work) Platforms***

##### **General Requirements:**

- All personnel lifts shall be operated in accordance with Occupational Safety and Health Administration (OSHA), appropriate ANSI standard and manufacturer requirements.
- The operator must be trained and qualified to operate the equipment.
- The equipment must be inspected pre-use daily.

##### **Fall Protection:**

- Fall Protection must be utilized as required by OSHA, ANSI/SAIA and the manufacturer.
- Note: The following activities require NREL EHS Office evaluation and acceptance prior to performing, and shall be considered “Hold Points”:
  1. Compromising the guardrail system
  2. Gaining elevation above the platform height
  3. Transitioning in or out of an elevated work platform or basket.

#### **11.3.3 Fall Protection on Roofs**

Subcontractors performing work on low-slope roofs (means a roof having a slope less than or equal to 3 in 12, vertical to horizontal) are permitted to perform work as prescribed below without the use of a conventional fall protection system. When this method of work area control is employed, a warning line system must be used for the purpose of keeping employees away from the roof edge.

No work activity or personnel access is permitted to take place in the area between the warning line and the roofs edge without a fall protection system in place.

##### **11.3.3.1      *Roofing Work***

Roofing Work, as defined by OSHA, means the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck work.

The following requirements apply to roofing work:

- When mechanical equipment is not being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge. When mechanical equipment is being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge which is parallel to the direction of mechanical equipment operation, and not less than 10 feet (3.1 m) from the roof edge which is perpendicular to the direction of mechanical equipment operation.
- The warning line meets or exceeds the requirements in §1926.502(f)(2).
- The employer effectively implements a work rule prohibiting the employees from going past the warning line unless the worker(s) is protected by a PFAS or restraint system when performing any activities in the area between the warning line and the roof edge.
- The use of a Safety Monitor without employing other accepted controls is prohibited at NREL.

#### **11.3.3.2 Other Trades Working on Roofs**

The following requirements apply to other trades performing work on roofs:

- A warning line is erected not less than 10 feet or more from the edge.
- The warning line meets or exceeds the requirements in §1926.502(f)(2).
- The employer effectively implements a work rule prohibiting the employees from going past the warning line unless the worker(s) is protected by a PFAS or restraint system when performing any activities in the area between the warning line and the roof edge.

#### **11.3.4 Subcontractor Training Requirements**

Subcontractors that are trained in accordance with the requirements identified in 29 CFR 1926, Subpart M will be considered as meeting the necessary fall protection training requirements for working at NREL. The subcontractor shall provide proof of such training as requested by the EHS Office. The subcontractor is required to provide authorized and competent persons site as defined in ANSI Z359.0 at the job site.

#### **11.3.5 National Wind Technology Center**

Work activities conducted at the National Wind Technology Center (NWTC) may be subject to additional fall protection system, training and rescue requirements which are contained in the NREL Laboratory Level Procedure, 6-4.14, Fall Protection. Contact the NREL NWTC EHS point of contact for additional requirements that may be applicable to that site.

### **11.4 NREL Special Emphasis**

#### **11.4.1 Personal Fall Arrest System (PFAS)**

The subcontractor shall ensure that PFAS are employed when conventional systems are not feasible to achieve 100% continuous fall protection at working heights of six feet or more. If PFAS's or conventional fall protection systems are not feasible, this justification shall be

documented in the fall hazard analysis outlined in Section 11.3.1.2 and accepted by the NREL Project Manager and EHS POC.

## **11.5References**

- 29 CFR 1926, Subpart M: Fall Protection
- 29 CFR 1926, Subpart R: Steel Erection
- NREL Laboratory Level Procedure, 6-1.53, Fall Protection
- ANSI A10.32-2004, Fall Protection Systems for Construction and Demolition Operations
- ANSI Z359-2007 Fall Protection Code.
- ANSI/SAIA A92.2-2009, Vehicle-mounted Elevating and Rotating Aerial Devices
- ANSI/SAIA A92.3-2006, Manually Propelled Elevating Aerial Platforms
- ANSI/SAIA A92.5-2006, Boom-supported Elevating Work Platforms
- ANSI/SAIA A92.6-2006, Self-propelled Elevating Work Platforms

# 12Hearing Conservation

## 12.1 Applicability

The requirements of this section apply to all Construction Subcontractors (hereafter referred to as “Subcontractor”) hearing conservation on NREL Sites unless otherwise specifically exempted by the NREL.

## 12.2Regulatory Requirements

Subcontractor Hearing Conservation Program shall meet or exceed requirements in the OSHA standard:

- American Conference of Governmental Industrial Hygienist, “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices,” 2005
- 29 CFR 1910.95 Occupational Noise Exposure  
[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9735](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9735).

## 12.3NREL Specific Requirements

Subcontractor Hearing Conservation Program shall meet or exceed requirements in the OSHA standard.

### 12.3.1 Control Measures

NREL uses a hierarchy of control measures to reduce noise levels as low as feasible. The order of precedence for mitigating hazards establishes the actions to be considered in an order of effectiveness to achieve intended risk reduction. The hierarchy is as follows:

1. Elimination or substitution of the hazards
2. Engineering controls
3. Work practices and administrative controls that limit worker exposures
4. Personal protective equipment (PPE).

Every feasible effort shall be made to “engineer out” noise exposures greater than or equal to an eight-hour, time-weighted-average (TWA) sound level of 85 decibels (dBA) on the A-weighted scale prior to using personal hearing protection as a noise attenuation device. When controls are not feasible or fail to reduce noise to acceptable levels, hearing protection shall be required. Additionally, if work is to be performed in an environment that is suspected to exceed the allowable noise exposures, mandatory hearing protection requirements shall be implemented.

### 12.3.2 Noise Evaluation

The Subcontractor shall survey and evaluate suspected high noise areas and work efforts. Employees may observe surveys and evaluations, and the results shall be made available to employees. Subcontractors must control employee exposures when noise levels meet or exceed 85 dBA as an 8-hr TWA, or if impact/impulse noise exceeds 140dBC. Maximum allowable noise exposure shall not exceed the permissible noise exposures shown in 29 CFR 1910.95 or the

ACGIH TLV's. Noise exposure shall be determined without regard to hearing protection provided.

### **12.3.3 High Noise Area Posting**

High noise areas shall be posted with appropriate warning signs at all entrances.

## **12.4References**

- 29 CFR 1910.95 Occupational Noise Exposure
- American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices," 2005
- NREL Laboratory-Level Procedure 6-1.43, Hearing Conservation Program.

## 13 Industrial Hygiene

### 13.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities regarding industrial hygiene matters as they relate to the construction activities on NREL Sites unless otherwise specifically exempted by the NREL.

This section defines the requirements and responsibilities for anticipating, recognizing, evaluating, and controlling employee exposures to chemical, physical, and biological agents encountered during construction activities. The Subcontractor industrial hygiene (IH) program shall address the following elements (as applicable to the project):

- Noise (See Chapter 12)
- Hazardous materials
- Subcontractor work site dust control
- Sanitation
- Personal exposure monitoring
- Respiratory protection
- Temperature extremes
- Lighting and illumination
- Ventilation
- Lead
- Hexavalent chrome
- Asbestos
- Lasers
- Safety showers and eyewash apparatus
- Ionizing radiation
- Blood-borne pathogens
- Other significant project-related hazards.

The Subcontractor shall provide personnel adequately trained/qualified to manage and implement their industrial hygiene program to a level required for the scope of work.

### 13.2 Regulatory Requirements

The subcontractor industrial hygiene program shall be conducted in accordance with the following statutory requirements:

- 10 CFR 851, Worker Safety & Health Program
- 29 CFR 1926, Construction
- 29 CFR 1910, General Industry
- American Conference of Governmental Industrial Hygienist, “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices,” 2005 as incorporated by 10 CFR 851.

### 13.3 NREL Specific Requirements/Permits

In addition to the requirements in Section 13.2, the subcontractor industrial hygiene program shall meet the following NREL requirements as applicable.

### **13.3.1 General Requirements**

#### **13.3.1.1 Identification of Health Hazards**

The Subcontractor shall identify and document, as part of the activity hazard analysis (AHA), existing and potential physical, chemical and biological health hazards. The AHA should include any additional hazards revealed by supplemental site information provided by NREL (e.g., site characterization data, as-built drawings, information regarding adjacent operations, etc.); and should be kept updated to reflect significant changes in exposure potential, new information, monitoring data, etc.

#### **13.3.1.2 Control Measures**

The Subcontractor's industrial hygiene program shall require that controls are implemented to eliminate or reduce employee exposures to below recognized occupational exposure limits (PEL's & TLV's). Subcontractors should strive to maintain exposures to as low as reasonably achievable (ALARA). Control measures to eliminate or reduce industrial hygiene-related exposures shall be identified during the pre-job planning process, and delineated in the AHA.

The implementation of control measures shall follow the following hierarchy:

1. Substitute to a less hazardous material if possible
2. Use engineering controls
3. Use administrative controls
4. Use PPE.

#### **13.3.1.3 Exposure Assessment**

The subcontractor shall perform monitoring as necessary to document employee exposures to chemical and physical hygiene hazards. Negative exposure assessments are encouraged even when not specifically required by a substance-specific standard. Exposure assessments may be performed using various methodologies (integrated sampling, direct-reading instrumentation, modeling, etc.), as appropriate for the material(s) of concern, the site conditions and the type of data needed.

### **13.3.2 Control of Hazardous Materials**

A hazardous material is any substance that presents a physical or health hazard to humans. Hazardous material exposures should be maintained at the lowest exposure levels practical. A chemical shall not be used in any situation unless an individual has information indicating how the material can be used safely. Control measures to prevent overexposure to chemicals shall be incorporated into the AHA as necessary.

#### **13.3.2.1 Carcinogen Control**

The Subcontractor shall make every attempt to substitute less hazardous substances for any carcinogenic material (as defined by OSHA in 29 CFR 1910.1200). If hazardous materials containing carcinogenic components are used, the subcontractor shall ensure that exposures are eliminated or effectively maintained as low as reasonably achievable (ALARA).



Where the Subcontractor's use of carcinogens may impact NREL workers, NREL may impose additional, specific controls upon the Subcontractor.

#### **13.3.2.2**      *Subcontractor Worksite Dust Control*

All Subcontractor projects shall address dust control during pre-job planning. Outdoor areas to be cleared for construction shall be limited to keep dust generation to a minimum. Earthwork activities shall be suspended when winds exceed 30 mph. Fugitive dust emissions resulting from grading and/or wind shall be controlled in accordance with the requirements of the Colorado Department of Public Health and Environment. Construction of permanent roadways and parking areas should be scheduled during the early stages of a project. During construction, frequent watering shall be provided to roadways and disturbed areas that are not otherwise treated. Although visible outdoor fugitive dust emissions are limited to 20%, the Subcontractor may need to perform worker exposure monitoring at much lower levels to demonstrate negative exposures to silica.

During facility renovation activities barriers are to be installed as needed to prevent dust migration from construction areas to other occupied space. Sufficient equipment shall be kept at the jobsite to control dust whenever a nuisance or hazard occurs. Indoors, dry sweeping is discouraged.

#### **13.3.3** *Sanitation*

Housekeeping shall be maintained on a daily basis. All work areas, shops and offices shall be kept clean to the extent the nature of the work allows. Walking/working surfaces shall be maintained, so far as practicable, in a dry condition. Waste receptacles that do not leak and may be thoroughly cleaned and maintained in a sanitary condition shall be used. All sweepings, wastes, refuse, and garbage shall be removed in a timely and sanitary manner. Cleaning and sweeping shall be done in a manner, which minimizes the contamination of the air with dust or particulate matter. Building entrances and openings shall be maintained to minimize the entry of vermin.

When provided, water facilities and containers shall be maintained, cleaned, and sanitized in accordance with applicable regulations. Use of common utensils (e.g., sharing the same cup) is prohibited. Adequate and fully-equipped toilets and wash stations shall be readily accessible to workers and maintained in a sanitary manner at all times.

##### **13.3.3.1**      *Personal Exposure Monitoring*

The subcontractor shall perform monitoring as necessary to document employee exposures to chemical and physical hygiene hazards, and to meet regulatory requirements. Negative exposure assessments are encouraged even when not specifically required by a substance-specific standard. Workers shall be informed of monitoring results within the OSHA-specified timeframe. Co-located workers (who have similar exposure potential as those who were monitored) shall also be informed of the results, after removing any personal/confidential information.

The subcontractor shall notify the NREL EHS point of contact of the results of monitoring as soon as they are obtained, and provide NREL with copies of the results, field notes and other associated documentation along with the weekly EHS report defined in Section 5.4.1.

### **13.3.4 Temperature Extremes**

Provisions to prevent heat stress and cold stress shall be incorporated into the project AHA(s) when work conditions may reasonably be expected to present such hazards. The Thermal Stress section of the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs) shall be the governing guidelines.

#### **13.3.4.1 Heat Stress**

The Subcontractor shall provide for appropriate mitigating measures prior to heat stress becoming an issue. The American Conference of Industrial Hygienists (ACGIH) threshold limit value (TLV) guidelines shall be followed for developing and implementing heat stress mitigation strategies. The use of heat stress controls shall be addressed during the planning stages for all work that is to be performed in elevated temperature environments, and whenever impermeable clothing or multiple layers of clothing shall be worn to conduct work.

#### **13.3.4.2 Cold Stress**

The ACGIH cold stress threshold limit value (TLV) is the prescribed standard for cold exposure. When work involves continuous employee exposure to an equivalent chill temperature (ECT) below 10° F, the following safe work practices shall be observed:

- Workers are instructed on symptoms of frostbite and hypothermia, and appropriate preventive and first aid measures.
- Warming areas are conveniently available and workers shall be allowed to access the warming areas at will.
- Work is conducted using the “buddy system” or under continued supervision.

Non-emergency work is curtailed when the ECT in the work area is below -25° F.

Workers who experience physical illness or injury from cold exposure are to be immediately moved to a warm area, and then examined by a physician.

### **13.3.5 Lighting and Illumination**

The minimum lighting level for construction areas both indoors and outdoors shall be an average of 5 foot candles measured 30 inches above the floor. Illumination for general construction plant and shop areas shall maintain an average lighting level of 10 foot candles. Auxiliary lighting shall be used when needed for task specific activities. Care shall be exercised with the use of halogen lamps so that fire hazards are not created.

### **13.3.6 Ventilation**

Local exhaust ventilation is a primary engineering control and is required to reduce concentrations of hazardous, irritating, and odiferous air contaminants below allowable exposure limits (where feasible). The operability of such systems shall be evaluated prior to the start of the work. The ACGIH’s Industrial Ventilation manual is the reference of standard for the design, testing and operation of ventilation systems. Ventilation systems requiring HEPA filtration should be leak- or DOP-tested at least annually to verify their effectiveness.

### **13.3.7 Silica Exposure**

The Subcontractor is responsible for keeping worker exposures to silica at, or below, the ACGIH TLVs, or the limits as calculated in OSHA's 1910.1000, Table Z-3, whichever is lower. In general, engineering controls such as wet methods or ventilation should be employed whenever dust-producing activities are anticipated. See also section 13.3.4, "Subcontractor Worksite Dust Control."

### **13.3.8 Lead Program**

Prior to performing work activities involving the use or potential release of lead, the Subcontractor shall provide a Lead Compliance Plan to NREL EHS for review and concurrence.

### **13.3.9 Hexavalent Chrome**

The Construction Industry Chromium (VI) Standard (29 CFR 1926.1126) will apply to all work performed by the Subcontractor that may expose workers to airborne hexavalent chromium. The Subcontractor shall be responsible for compliance with all requirements of the Standard.

### **13.3.10 Asbestos**

No disturbance of presumed or known asbestos-containing materials shall take place unless authorized by NREL EHS in the CSWP. If suspect asbestos-containing materials are unexpectedly encountered during the course of construction activities, the Subcontractor shall immediately cease work and contact the NREL Project Manager or NREL EHS POC. Asbestos-containing construction/building materials shall not be brought on-site without the express, advance and written consent of NREL.

The Subcontractor conducting asbestos-related work shall be responsible for compliance with the OSHA Construction Standard 29 CFR 1926.1101, Colorado Regulation 8 Part B and the requirements below.

The Asbestos Abatement Subcontractor shall:

- Submit an Asbestos Work Plan which provides detailed information on how the work is to be performed. Type of information to be included is critical barriers, work practices, removal/disturbance methods, and signs and labels to be used; air monitoring to be performed; and waste handling procedures (packaging, disposal site). This plan shall be submitted to EHS for review and concurrence prior to starting work. Work shall comply with the requirements set forth in 29 CFR 1926.1101 and Colorado Regulation 8.
- Submit notification to the State of Colorado if the amount of material to be removed is > 260 linear feet or the volume is equivalent of one 55 gallon drum. Provide a copy of that notification if required to EHS.
- Work shall be performed in a regulated area.
- Maintain copies of Asbestos Worker Certification at the site for inspection by EHS.
- Provide copy of Asbestos Supervisor Certification to EHS.
- Provide copy of General Abatement Subcontractor Certification to EHS.

- Provide copy of workers respiratory protection certification to EHS.
- Provide proof of insurance covering asbestos abatement activities that extends the length of the project to EHS.
- Provide copies of all air monitoring results to EHS once received.
- Request EHS to review and sign Waste Disposal Manifest prior to removing waste from site and provide copy of manifest to EHS. Asbestos waste may not be combined with waste from other projects. It shall be shipped directly to a landfill and may not be stored in an intermediate satellite storage location.
- Prepare an activity hazard analysis (AHA) for the asbestos abatement activity and submit to the NREL Project Manager and EHS POC for review and concurrence.

### **13.3.11 Lasers**

Class 1 laser systems incorporated into commercially available devices for use by the general public are exempt from these requirements, unless opened, serviced or modified. Laser equipment shall bear a conspicuously displayed label to indicate hazard classification.

Users of Class 1, Class 1M, Class 2, Class 2M, Class 3a, or Class 3R lasers shall read and abide by the safety documentation provided in the operator's manual. Only qualified and trained personnel may service, adjust, or repair laser equipment. Employees, when working in areas in which a potentially hazardous exposure to direct or reflected laser radiation exists, shall be provided with anti-laser protection devices.

#### **13.3.11.1 Class 3B and Class 4 Laser Use**

Class 3B and 4 laser equipment shall not be used without the express written permission of the NREL Laser Safety Officer.

### **13.3.12 Safety Showers and Eyewashes**

Suitable facilities for quick drenching or flushing of the eyes and body (e.g., eyewash/shower apparatus) shall be provided within the work area for immediate emergency use where the eyes or body of any person may be exposed to injurious corrosive materials (e.g., corrosives, skin sensitizers, etc.). An eyewash/shower apparatus shall be located such that it would require no more than 10 seconds to reach from the hazard. Access shall be free of any impediments. For battery handling areas, facilities for quick drenching of the eyes and body shall be provided within 25 feet.

Employees who may have a need for an eyewash/shower apparatus shall know where the nearest eyewash/shower apparatus is located and how to operate it. Monthly functional testing of eyewash/shower apparatus shall be documented. The potable water provided for a portable eyewash/shower apparatus shall be flushed or changed according to manufacturer's specifications.

### **13.3.13 Ionizing Radiation**

Radioactive materials, sealed radioactive sources, or devices that generate ionizing radiation shall not be brought on the NREL site without express written permission of the NREL Radiation Safety Officer. Any Subcontractor needing to bring radioactive material, sources or

radiation-generating devices onto NREL property shall allow sufficient lead time in their schedule for NREL's review of their program, documentation, training records, other submittals, etc.

#### **13.3.14      *Blood-Borne Pathogens***

Employees who may reasonably be expected to be exposed to blood or other body fluids shall comply with OSHA/ requirements relating to this subject. First aid kits shall contain "Universal Precautions" items, including chemical splash goggles, medical gloves, cardiopulmonary resuscitation (CPR) masks (with one-way valve), antiseptic hand cleaner, drying cloths, and red bags labeled "BIOHAZARD." Medical waste generated as a result of first aid response shall be placed in labeled red bags, and disposal coordinated through NREL's Occupational Health Services.

#### **13.3.15      *Other Health Hazards***

Other hazards that may be present during the course of the Subcontractor's work which is not specifically addressed in this manual shall be identified by the Subcontractor and addressed in their AHA(s). Subcontractors are encouraged to discuss their potential hazards in advance with NREL EHS and/or the NREL Project Manager to help ensure minimal impact to the project schedule and the smooth coordination of logistics.

### **13.4 NREL Special Emphasis**

Some chemicals are considered by NREL to be extremely hazardous and have additional requirements for bringing on NREL property and/or specific worker exposure monitoring requirements (see section 15.4 for a listing of extremely hazardous chemicals).

Additionally, subcontractors performing work on LEED projects are required by their contract to use low-emitting indoor paint and coating materials in accordance with the identified LEED criteria in order to reduce the quantity of indoor contaminants that are odorous, irritating and or harmful to the comfort and well-being of installers and occupants.

Subcontractors performing work on projects that are not LEED, are also encouraged to utilize LEED criteria as a best management practice during the selection and application of indoor paint and coatings when applicable to their scope of work.

### **13.5 Subcontractor Responsibilities**

**13.5.1** The provisions of this procedure apply to the development and implementation of the Subcontractor's industrial hygiene program. The Subcontractor shall be responsible for implementing an effective IH program that:

- Identifies, evaluates, and controls potential and existing hazards/agents in the workplace through the pre-job safety planning process.
- Determines that engineering devices, administrative controls, and personal protective equipment are available, appropriate, tested, and utilized by employees.
- Determines employees are trained as required.
- Stops work that is not being safely performed.

- Reports occupational exposure data to affected employees in a timely manner.

### **13.6References**

- 29 CFR 1910, Occupational Safety and Health Standards
- 29 CFR 1926, Safety and Health Regulations for Construction
- American Conference of Governmental Industrial Hygienists, “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices,” 2005
- American Conference of Governmental Industrial Hygienists manual, “Industrial Ventilation”, current edition
- Colorado Department of Public Health and Environment, Regulation 8, Part B - Asbestos
- Colorado Department of Public Health and Environment, Regulation 3 - Stationary Source Permitting and Air Pollutant Emission Notice Requirements.

## **14 Personal Protective Equipment (PPE)**

### **14.1 Applicability**

The requirements of this section apply to all Construction Subcontractors' and lower-tier subcontractors' (hereafter referred to as "Subcontractor") construction work activities on NREL Sites unless otherwise specifically exempted by the NREL. This section provides the requirements for the use of personal protective equipment, where substitution, engineering or administrative controls are inadequate to fully protect the worker's body (including eyes, face, feet, hands, head, and hearing) from hazards capable of causing injury, illness, or impairment of any bodily function.

### **14.2 Regulatory Requirements**

The selection, use, and design of PPE shall comply with the following requirements:

- 29 CFR 1926, Construction, Subpart E; Personal Protective and Life Saving Equipment
- 29 CFR 1926, Construction, Subpart I; Personal Protective Equipment
- 10 Code of Federal Regulations (CFR) 835, Occupational Radiation Protection
- Applicable American Standards Institute (ANSI) standards
- Manufacturers' recommendations.

### **14.3 NREL Specific Requirements/Permits**

#### **14.3.1 General Requirements**

Personal protective equipment (PPE) is not a substitute for engineering and administrative controls. These controls shall be implemented, to the extent feasible, to mitigate the hazard so that the need for PPE is reduced or eliminated. Subcontractors shall provide PPE to its employees in accordance with OSHA requirements.

At a minimum, all subcontractor personnel shall wear sturdy work shoes, long pants, and shirts with 4 inch sleeves when performing field work. Personnel working on construction activities or in the field shall also wear hard hats, safety glasses with rigid side-shields and reflective, high visibility (e.g., orange) traffic safety vests (minimum ANSI Class 2). Exceptions to these minimum requirements shall be approved by the NREL EHS office and notated in the activity-specific AHA.

The subcontractor is responsible for supplying and requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions and/or where this manual indicates the need for using such equipment to reduce the hazards to the employees.

#### **14.3.2 Training**

Subcontractors shall provide training to each employee who is required to use PPE. Each affected employee must show understanding of training to their specific PPE. Retraining may be necessary if work activities change or the employee exhibits lack of understanding of the PPE.

### **14.3.3 Specific Requirements**

#### **14.3.3.1 PPE Hazard Assessment and Selection**

The appropriated PPE for the work being performed shall be specified in the applicable AHA. The PPE selection shall be based on the hazard assessment results conducted for the work activity. Examples of applicable hazard assessment documentation include:

- Activity hazard analysis (AHA) or job safety analysis
- Fall Protection Plan
- Confined Space Entry Permit
- Hot Work Permit
- Electrical Safe Work Permit
- Building Surface Penetration Permit
- Other work control documents.

The AHA shall address at a minimum following PPE requirements as applicable to the work activity:

- Foot protection
- Hand protection
- Respiratory protection
- Head protection
- Eye and face protection
- Hearing protection
- Body protection
- Fall protection.

### **14.4 Subcontractor Responsibilities**

The subcontractor shall:

- Perform an assessment identifying hazards or potential hazards and determine necessary PPE for activities to be performed
- Include PPE requirements in project AHAs, as applicable
- Adhere to prescribed NREL postings and/or NREL pre-job planning documentation requiring use of PPE
- Provide adequate PPE for all its employees
- Properly maintain, use and store PPE
- Remove damaged and/or defective equipment from service



- Provide appropriate training to PPE users and document through site-specific training, and/or daily safety meetings.

## **14.5 References**

- 29 CFR 1910, Occupational Safety and Health Standards
- 29 CFR 1910.134, Respiratory Protection
- 29 CFR 1926, Safety and Health Regulations for Construction
- 29 CFR 1926, Subpart E; Personal Protective and Life Saving Equipment
- 29 CFR 1910, Subpart I; Personal Protective Equipment
- 10 Code of Federal Regulations (CFR) 835, Occupational Radiation Protection
- ANSI Z87.1, Occupational and Educational Personal Eye and Face Protection Devices
- ANSI Z89.1, Protective Headwear for Industrial Workers
- American National Standards Institute (ANSI) Z88.2, “American National Standard for Respiratory Protection,” (1992)
- ASTM F2413-05 Standard Requirements for Protective Footwear.

## **15 Hazard Communication**

### **15.1 Applicability**

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities involving hazardous materials as they relate to the construction activities on NREL Sites unless otherwise specifically exempted by the NREL.

This section defines the requirements and responsibilities for subcontractors who use, apply, store or generate hazardous materials at the NREL.

### **15.2 Regulatory Requirements**

The Subcontractor’s Hazard Communication program shall be conducted in accordance with the following statutory requirements:

- 10 CFR 851, Worker Safety & Health Program
- 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Standards
- 29 CFR 1926.59, Hazard Communication, Safety and Health Regulations for Construction.

The Hazard Communication Program shall comply with the applicable statutory requirements of 29 CFR 1910.1200, Hazard Communication. Required components of a Hazard Communication Program include hazard determination, safety data sheets (SDS), labels and other forms of warning, employee information training, and a written Hazard Communication Program defining the above.

### **15.3 NREL Specific Requirements/Permits**

In addition to the requirements in Section 15.2, the subcontractor’s Hazard Communication program shall meet the following NREL requirements as applicable.

#### **15.3.1 General Requirements**

When selected for subcontract award, submit for approval, prior to beginning work, a list of all hazardous materials to be used on the project to the Subcontract Administrator with copies to the NREL EHS Office and NREL Project Manager.

The subcontractor is responsible for maintaining an up-to-date chemical inventory and copies of material safety data sheets (only of those chemicals brought on site). These shall be maintained at the task or project support facilities and made readily available for review by site workers, the DOE or NREL employees. The list (inventory) may include a book of SDSs, appropriately labeled and periodically updated to reflect the workplace inventory.

Prior to using any newly introduced hazardous material or product, supervisors shall obtain a copy of the appropriate SDS and review it with their employees. Project activity hazard analyses should be updated to reflect health and safety controls specific to chemical use.

Each original container of hazardous materials shall have the manufacturer's label affixed to it or be labeled, marked, or tagged showing the identity of the hazardous chemicals, the appropriate hazard warning, and the name and address of the chemical manufacturer, importer, or other responsible party.

Secondary and subsequent containers of hazardous chemicals shall be labeled, marked, or tagged prior to use with the identity of the hazardous materials and the appropriate hazard warnings. The only exception to this is for portable containers into which hazardous chemicals are transferred, which need no label if all of the following conditions are met:

- The contents of the portable container are for the immediate use of only the person making the transfer, and the container remains under their direct control.
- The unlabeled portable container is used only within the work shift during which it was originally filled.

### **15.3.2 Specific Communication Requirements**

If the subcontractor uses a labeling system that is an unusual format, or not readily understandable, the subcontractor shall inform other affected workers of how to read/understand their labeling system.

The subcontractor shall determine if their use of hazardous materials may affect (expose, or pose a potential danger in the event of an emergency) other subcontractor or NREL employees. If the hazardous materials form or the way it will be used creates a potential for affecting other employees, the subcontractor shall take appropriate notification steps. The subcontractor shall inform the other employer(s) of any precautionary measures that need to be taken to protect other subcontractor and/or NREL employees from inadvertent/unnecessary exposure to the subcontractor's hazardous materials during normal operating conditions and in foreseeable emergencies.

Work areas where chemical and/or biological hazards are known to pose an exposure potential shall be clearly designated as such (with signs, placards, postings, etc.) along with control requirements (PPE requirements, ventilation, authorization for access required, etc.).

## **15.4 NREL Special Emphasis**

Some chemicals are considered by NREL to be extremely hazardous and have additional requirements for bringing on NREL property. Extremely hazardous materials at NREL include the following classes of chemicals:

- Alkali metals
- Beryllium
- Perchloric acid and other peroxide-forming chemicals
- Unstable, reactive, pyrophoric, or explosive chemicals
- Hydrofluoric acid
- Radioactive materials

- Highly toxic chemicals and reproductive toxins (depending upon the form, the quantity and method of application or use)
- Pesticides/herbicides
- Bio-chemicals.

Use of these chemicals at NREL may necessitate additional control mechanisms such as establishing dedicated use areas, specific postings/warning signs, notification to adjacent workers, ventilation controls, decontamination procedures, personal hygiene facilities, etc. It is the subcontractor's responsibility to notify the NREL EHS point of contact prior to bringing the material on site (preferably during the project planning stages) if intending to use extremely hazardous materials on their project, in order to ensure that the proper controls are built in.

## **15.5 Subcontractor Responsibilities**

The Subcontractor shall be responsible for:

- Administering their own Hazard Communication Program.
- Maintaining an on-site list of hazardous materials and SDSs to be used on the project.
- Determining the hazards of materials used in the workplace, making SDSs available to employees, labeling containers, and providing information and training to employees on hazardous materials.
- Developing work practice requirements for hazardous materials identified in the AHA.
- Bringing on-site only those chemicals needed to perform the work for which they are contracted, and only in quantities needed for the job at-hand.
- Identifying when the subcontractor's use of hazardous materials may affect (expose, or pose a potential danger in the event of an emergency) other subcontractor's, or NREL's, employees and taking appropriate notification steps.
- Storing chemicals in accordance with the manufacturer's instructions, applicable regulations and best management practices.
- Remove chemicals from the work area and properly dispose of them when no longer needed.
- Comply with exposure monitoring and medical surveillance requirements associated with chemical use.

## **15.6 References**

- 10 CFR 851, Worker Safety & Health Program
- 29 CFR 1926, Safety and Health Regulations for Construction
- 29 CFR 1910, Occupational Safety and Health Standards for General Industry.

## 16 Confined Space

### 16.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities which require personnel to work in permit-required and non-permit-required confined spaces on NREL Sites unless otherwise specifically exempted by the NREL.

### 16.2 Regulatory Requirements

The Subcontractor confined space entry program and the associated work activities conducted in permit-required and non-permit-required confined spaces shall be accordance with the following statutory requirements:

- 29 CFR 1910.146, Permit Required Confined Spaces

### 16.3 NREL Specific Requirements/Permits

In addition to meeting the OSHA requirements in Section 16.2, all work activities conducted in permit-required and non-permit-required confined spaces shall meet the following NREL requirements, as applicable.

#### 16.3.1 Confined Space Work at NREL

If known at the time of contracting, NREL will include information on the need for confined space entry in the request for proposal (RFP). NREL will describe the confined space, whether it is permit-required or non-permit-required, the known hazards of the space, and the purpose for entry. NREL will request and review a copy of the Subcontractor’s written confined space program. NREL will require the Subcontractor to have a competent confined space person, workers who are properly trained in confined space entry, and all the necessary equipment to perform work in the confined space. Compliance verification is further described in Section 7.3.4.

#### 16.3.2 Confined Space Classification

NREL has established a system for classifying (consistent with OSHA definitions) confined spaces as permit-required or non-permit-required based on the actual and/or potential hazards related to entry into the space. Prior to entry, all confined spaces will be evaluated and classified as either permit-required or non-permit based on the actual and/or potential hazards related to entry into the space while the confined space is in its normal operating condition. Confined space classification is performed in advance of entries by NREL EHS.

##### 16.3.2.1 *Labeling and Signage*

When feasible, identified confined spaces are posted with a sign stating “Confined Space, Entry by Permit Only” or “Caution, Non-Permit Confined Space, Contact the NREL Central Monitoring Station (CMS (303-384-6811) and building area engineer (BAE) Before Entering.” When signage is not feasible Subcontractors will be informed of the location and classification of known confined spaces.

### **16.3.3 New or Previously Unidentified Confined Spaces**

There is a possibility that construction activities may create new confined spaces (such as new utility vaults, manholes, ventilation ducts, tanks, sumps, and/or elevator pits). It is also possible that, during construction, Subcontractors may encounter a confined space that had not been previously identified. During project design, NREL will attempt to identify situations that may result in the creation of new confined spaces; however it is not always possible to anticipate every potential confined space.

It is the Subcontractor's responsibility to watch for new or previously unidentified confined spaces and to inform the NREL project manager whenever new confined spaces are identified or created.

#### **16.3.3.1 Identifying a Confined Space**

All Subcontractors should be on the lookout for confined spaces. As defined by OSHA a confined space is:

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry)
- Is not designed for continuous employee occupancy.

#### **16.3.3.2 Hazard Recognition**

Confined spaces shall be considered hazardous until determined to be otherwise. Hazards will be identified and evaluated by a competent person prior to entry. The Subcontractor shall be watchful of confined space work activities that may increase hazards, such as hot work, painting, cleaning or electrical work. Such work may change a non-permit-required confined space into a permit required confined space. The Subcontractor will continuously evaluate of confined space conditions and will stop work if hazards increase or change. Additional controls shall be implemented to control the new hazards. In addition to the requirement for an entry supervisor and attendant for permit-required entries, non-permit entries require a partner or buddy to be involved with each entry.

### **16.3.4 NREL Verification of Subcontractor's Compliance with Confined Space Entry**

NREL will require verification that the Subcontractor is able to safely perform confined space entries. NREL will verify that the Subcontractor has the following:

- A confined space competent person
- The entry team/authorized personnel—adequate number of workers to staff an entry team including entry supervisor and that their training is current and documented
- Functioning, calibrated monitoring equipment and that their staff are familiar with the use of the equipment

- Appropriate PPE, ventilation equipment, supplemental lighting if necessary, rescue equipment/plan.

NREL and the Subcontractor will discuss acceptable entry conditions. NREL may request a copy of the Subcontractor's Lockout Tagout program if energy isolation is necessary. NREL and the Subcontractor will agree who's permit system will be used—either NREL's or the Subcontractor's. NREL EHS may observe Subcontractor confined space entries until such time that NREL is comfortable that all performance expectations are being met. A copy of each completed confined space entry permit must be submitted to NREL EHS.

#### **16.3.4.1      *Confined Space Entry Controls***

Entries into confined spaces shall be controlled either through administrative controls for non-permit confined spaces or through the permit procedure for permit-required confined spaces. Controls for confined space entries include, but are not limited to:

- Mechanical ventilation
- Use of isolation procedures (LOTO)
- Cleaning of confined space
- Electrical precautions
- Fire precautions
- PPE
- Communication procedures.

#### **16.3.4.2      *NREL Confined Space Entry Experience/History Review***

NREL EHS shall inform Subcontractors of NREL's experience, if any, with the confined space being entered, by reviewing, Confined Space Evaluations, and associated confined space classification, and previous cancelled permits for the space in question, if available.

#### **16.3.4.3      *Subcontractor Confined Space Post Entry Evaluation Review***

Subcontractors shall inform NREL EHS of their experience with the permit-required confined space following the entry by utilizing the "Entry Review/Critique" section contained in the NREL Confined Space Entry Permit or as part of the Subcontractor's accepted Confined Space Entry Permit. Completed NREL permits or copies of the Subcontractor's permit shall be made available to NREL EHS.

#### **16.3.5 *Confined Space Entry Notification***

In general, the following coordination and notification (the NREL Project Manager will be responsible for providing the necessary phone numbers) is required for permit and non-permit required confined spaces prior to entry.

**Non-Permit Confined Space:** Entries shall be coordinated with the Central Monitoring Station (CMS) and the BAE.

**Permit-Required Confined Space:** Entries shall be coordinated with the CMS, BAE, and EHS.

The project manager will provide phone numbers and will instruct the Subcontractor of specific notifications to be made. Exact notification requirements may vary from job to job, particularly in cases of new confined spaces arising during construction.

#### **16.3.6 Subcontractor Training Requirements**

Subcontractors that are trained in accordance with the requirements identified in 29 CFR 1910.146, Permit Required Confined Spaces will be considered as meeting the necessary confined space entry training requirements for working at NREL. The Subcontractor shall provide NREL proof of such training upon request.

#### **16.4 References**

- 29 CFR 1910.146, Permit Required Confined Spaces
- NREL Laboratory Level Procedure 6-1.52, Confined Space Entry.



## 17 Building Surface Penetrations

### 17.1 Applicability

The requirements of this section apply to all Construction Subcontractors and lower-tier subcontractors (hereafter referred to as “Subcontractor”) activities involving the penetration of building surfaces such as walls, floors, ceilings, and roofs, specifically with respect to preventing contact with hidden hazards such as live electrical conductors and other significant hazards such as natural gas, water lines, and compressed air as they relate to the construction activities on NREL Sites unless otherwise specifically exempted by the NREL.

### 17.2 Regulatory Requirements

The subcontractor’s building surface penetration activities shall be conducted in accordance with the following statutory requirements as applicable:

- 29 CFR 1926, Safety and Health Regulations for Construction
- 29 CFR 1910, Occupational Safety and Health Standards.

### 17.3 NREL Specific Requirements/Permits

In addition to the requirements in Section 17.2, the subcontractor shall conduct surface penetrations in accordance with the following NREL requirements. **Note:** All outside excavations including trenching, grading, or drilling activities shall be performed in accordance with Chapter 8, Excavations.

#### 17.3.1 Surface Penetrations

A **surface penetration** at NREL is defined as an opening made by drilling, cutting, hammering, or otherwise piercing a wall, floor, ceiling, roof or other building surface. Subcontractors shall ensure that the provisions and necessary steps are in place to provide protection against contact with unseen enclosed electrical lines, gas lines, waste lines, water lines, high pressure lines, or other utilities that, if disturbed, may injure workers or damage equipment.

The subcontractor will be responsible for providing all the required materials, personnel and protective equipment necessary to conduct safe surface penetrations.

##### 17.3.1.1 *Surface Penetration Permit, Existing NREL Buildings and Facilities*

Subcontractors conducting surface penetrations in existing NREL buildings and facilities shall perform this work activity in accordance with the NREL Surface Penetration Permit System. Prior to performing any building surface penetrations, the subcontractor shall coordinate the activity through the NREL Project Manager and existing Building BAE. The NREL Project Manager/BAE will issue the surface penetration permit to the subcontractor.

In accordance with the requirements of the permit, the subcontractor shall perform an initial evaluation to include a walk-down of the area with the NREL Project Manager/BAE. The walk-down shall identify:

- Any visible indications that utilities and equipment might be present
- Any utilities and equipment that might be disturbed during the work activity.

### **Preapproved Surface Penetration Methods**

Based on the results of the walk-down, the NREL Project Manager/BAE will make a determination if the subcontractor work activity falls within the category of a “preapproved surface penetration method.” NREL’s preapproved methods include the following:

- Hanging pictures or board where the length of the nail or screw will not fully penetrate the wall material.
- Penetrations into masonry block wall that do not exceed  $\frac{3}{4}$ ” in depth.
- Penetrations in pre-cast tilt-up concrete walls to mount signs and facility accessories. The penetration cannot exceed the thickness of the wall.
- Penetrations in drywall, sheetrock, or similar construction material with a drill bit fitted with a stop to prevent penetration beyond the depth of the material. Once a hole is made just through the material, use a fiber optic scope to verify the absence of utilities prior to proceeding with work.
- Penetrations in drywall, sheetrock, or similar construction material with a utility knife where the blade is adjusted to prevent penetration beyond the depth of the material. If the size of the opening does not allow for visual verification, use a fiber optic scope to verify the absence of utilities prior to proceeding with work.
- Penetrations in drywall, sheetrock, or similar construction material with a non-conductive object. If the size of the opening does not allow for visual verification, use a fiber optic scope to verify the absence of utilities prior to proceeding with work.
- Penetrations in drywall, sheetrock, or similar construction material with a laminate trimmer with the cutting bit adjusted to prevent penetration beyond the depth of the material. If the size of the opening does not allow for visual verification, use a fiber optic scope to verify the absence of utilities prior to proceeding with work.
- Penetrations into a single layer of drywall, sheetrock, or similar construction material where both sides can be visually inspected to verify the absence of utilities that may be disturbed

If it is determined that the surface penetration meets the requirements of a preapproved method, then the NREL Project Manager/BAE will issue the permit to the subcontractor. The permit may include additional subcontractor project controls and work instructions as deemed necessary by the BAE.

### **Non Preapproved Surface Penetration Methods**

If the surface penetration does not meet the criteria for a “preapproved surface penetration method,” then one or more of following utility locate measures as determined by the NREL BAE, Project Manager and EHS point of contact shall be applied:

- Review facility and the utility drawings.
- Perform nondestructive examination of the area with utility locate equipment.

- Interview individuals involved with the construction of the area to identify how utilities were laid out.
- Use typical construction practices as an indicator of the potential for utility system to be disturbed.
- Other as applicable.

The subcontractor shall incorporate the following electrical safety precautions as required by the permit:

- GFCI when using corded electrical power tools  
Note: A CFGI is not required if a drill interrupter/ stop is used.
- Drill interrupter/stop
- Wear dielectric gloves rated for the voltage
- Eye protection
- Dielectric mats
- Wear dielectric rubber outer boots over required foot protection when using water coolant or in a wet environment.

When utilities have been detected within the general area that the penetrations will be performed, the subcontractor shall incorporate that following project controls and instructions as applicable and defined in the permit:

- Relocate planned penetration location.
- Maintain the distances from the identified and marked utilities as defined in the permit.
- Lock out/tag out the detected utilities prior to proceeding with the surface penetration activities.

In all instances, the subcontractor shall immediately stop work if:

- Unexpected utilities are encountered
- The tools encounter unexpected resistance
- Utilities are damaged during the work activity.

#### **17.3.1.2**      *Surface Penetration Permit, New Building Construction*

Subcontractors performing building penetrations in or on new building construction shall utilize their own surface penetration permit system that meets or exceeds the requirements of Section 17.3.1.1. The Subcontractor shall utilize the permit when construction activities such as drilling, cutting, hammering, or otherwise piercing a wall, floor, ceiling, roof or other building surface. that have a possibility of contacting or penetrating energized unseen enclosed electrical lines, gas lines, waste lines, water lines, high pressure lines, or other utilities that, if disturbed, may injure workers or damage equipment.

The Subcontractor surface penetration permit system shall be included as part CEHSP when applicable to project scope.

## **17.4References**

- NREL Laboratory-Level Procedure 6-1.63, Safe Penetration of Building Surfaces
- 29 CFR 1926, Safety and Health Regulations for Construction
- 29 CFR 1910, Occupational Safety and Health Standards.

## **18 Environmental Requirements**

### **18.1 Applicability**

The requirements of this section apply to all Construction Subcontractors and lower-tier subs (hereafter referred to as “Subcontractor”) activities which have the potential to affect natural resources that include stormwater, wetlands, streams, air quality, vegetation and wildlife. Potential impacts to existing historical and archeological items as well as historical and archeological items unearthed during construction on NREL sites are also addressed in this section. Any exceptions to these requirements must be approved by NREL.

### **18.2 Regulatory Requirements**

Environmental protection is addressed through the following statutes/laws/regulations and guidance documents:

- National Environmental Policy Act (NEPA)
- Clean Water Act, Section 404
- National Historic Preservation Act
- Endangered Species Act
- Migratory Bird Treaty Act of 1918
- Bald and Golden Eagle Protection Act
- 40 CFR Part 122, Subpart B, National Pollutant Discharge Elimination System
- State of Colorado Noise Statute (CRS 25-12-101 through CRS 25-12-109)
- Colorado Department of Public Health and Environment, Air Pollution Control Division, Particulates, Smokes, Carbon Monoxide and Sulfur Oxides, Regulation No. 1
- Colorado Division of Wildlife Recommended Buffer Zones and Seasonal Restrictions for Colorado Raptors, 2008
- Colorado Noxious Weed Act (CRS 35-5.5-101 thru 119) and associated regulations, Rules Pertaining to the Administration and Enforcement of the Colorado Noxious Weed Act (8 CCR 1206-2).

### **18.3 NREL Specific Requirements/Permits**

In addition to Section 18.2, all work activities shall meet the following NREL requirements, as applicable.

#### **18.3.1 National Environmental Policy Act Requirements (NEPA)**

A provisional NEPA review may have been initially completed so that the project design could be completed. Once the details of the project have been described in the preliminary design, but before initiation of construction activities, additional environmental review may be required. Depending on the nature and scope of the activity, the environmental review process could take a few days to several weeks.

### **18.3.2 Stormwater Discharge Requirements**

Stormwater discharges associated with construction sites that disturb greater than one acre at NREL's STM and NWTC sites are regulated by the EPA via the EPA General Construction Permit. Subcontractors performing construction activities on these sites are responsible for obtaining coverage under the EPA's Construction General Permit. This requires filing a Notice of Intent with the EPA and preparation of a Stormwater Pollution Prevention Plan (SWPPP). Subcontractors are required to utilize a template provided to them by NREL EHS Office for preparation of the SWPPP. The NREL EHS Office shall review and accept the subcontractor SWPPP in advance of applying for EPA coverage and before beginning construction activities.

Construction activities that disturb less than one acre do not require coverage under the EPA Construction General Permit. However, the subcontractor shall prepare a site specific erosion control plan that shall be accepted by NREL EHS before construction activities can begin. SWPPP shall include a spill prevention, response and cleanup plan.

### **18.3.3 Air Emissions Requirements**

#### **18.3.3.1 Fugitive Dust**

The Subcontractor shall adhere to NREL's Particulate Emissions Control Plan for Construction Activities (state air permit numbers 08JE0889L and 04JE1442L).

#### **18.3.3.2 Vehicular Emissions**

Construction vehicles, equipment, and subcontractor's personal vehicles shall be operated to minimize emissions. Unnecessary idling of vehicles and equipment is prohibited. Idling of vehicles for occupant heating/cooling comfort is prohibited. Colorado Revised Statute No. 4241206.

#### **18.3.4 Pipe Flushing**

Pipeline flushing of new water lines, storm and sanitary sewer lines, or fire line flushing requires preparation and approval by NREL EHS of a plan that describes the location and nature of activity to be performed, description of the discharge (duration, anticipated volume and rate, source of the water, potential pollutants in the water used), and the BMPs to be used to prevent potential pollutants from reaching the storm drainage system, a stream, drainage channel, ditch or groundwater.

Flushing water may be discharged to the Pleasant View Water and Sanitation District's sanitary sewer system, if approved by the District. Coordination with NREL EHS is required for all pipe flushing activities that have the potential to reach the storm drain system, a stream drainage channel, ditch or groundwater.

#### **18.3.5 Trash, Construction Debris, and Sanitary Waste**

The Subcontractor shall provide waste storage and removal as required to maintain the construction site in a clean and orderly condition with periodic disposal of waste off-site. Open free-fall chutes and containers without lids are prohibited. Trash and debris is prohibited from migrating outside the construction area. All trash and debris is to be collected daily.

### **18.3.6 Wastewater**

NREL limits wastewater discharges to sewer or septic systems. NREL does not permit other direct wastewater discharges to the environment, including land and surface water. NREL complies with Pleasant View Water and Sanitation District (Pleasant View) and Metro Wastewater Reclamation District (Metro) prohibitions, criteria, restrictions, and notification requirements for wastewater discharges. Discharges of large volumes of wastewater (25,000 gallons per day or greater) require a special permit from the wastewater districts. Contact NREL EHS if such a volume is planned on a routine, periodic, or occasional basis.

### **18.3.7 Hazardous Waste**

NREL holds the necessary Resource Conservation and Recovery Act (RCRA) generator identification numbers to conduct waste generation and collection activities. NREL prohibits treating (evaporation, neutralization, dilution, or reduction of volume or toxicity) or disposing of hazardous waste on site. The Subcontractor shall contact NREL EHS prior to any construction activity that will generate hazardous or chemical waste. Special handling, storage, and labeling requirements may apply depending upon the type and quantity of chemical waste. The Subcontractor shall adhere to NREL Procedure 6-2.10 Spill Prevention, Control and Countermeasures for the South Table Mountain Site, which applies to where liquid fuel and oil is stored, processed, distributed, or consumed, and could reasonably be expected to discharge oil in harmful quantities.

### **18.3.8 Asbestos**

The use of asbestos containing material (ACM) is not authorized. However, it is possible that unidentified ACM may be discovered during excavation activities. Should ACM be discovered, the Subcontractor shall stop the affected work and notify the NREL Project Manager.

### **18.3.9 Noise**

Per State of Colorado Noise Statute, construction projects are limited to permit conditions or 80 dBA for the period within which the construction is to be completed or a reasonable amount of time.

### **18.3.10 Pesticide and Herbicide Use**

All pesticide and herbicide use shall be approved by the NREL EHS prior to application.

### **18.3.11 Vegetation**

Project design shall attempt to minimize the elimination of existing trees/shrubs, which provide local wildlife habitat, reduce cooling needs in summer by providing shade, and remove carbon dioxide from the air, thus contributing to a reduction of greenhouse gases generated at NREL. Those trees/shrubs that must be eliminated as a result of construction shall be tagged/otherwise marked and noted on construction drawings to be reviewed by NREL EHS. Removal of existing trees/shrubs will require replacement. The Integrated Project Team (IPT) together with NREL EHS will determine replacement strategies (types of trees, number to be replaced, etc.). Work sites shall be restored by reseeded per requirements specified in NREL procedures 6-2.15 and 6-2.16.

### **18.3.12**      *Natural Resources—Wildlife*

Natural resource protection at NREL is guided by NEPA, the Migratory Bird Treaty Act, the Colorado Division of Wildlife Recommended Buffer Zones and Seasonal Restrictions for Colorado Raptors, the Threatened and Endangered Species Act, and other applicable state and federal wildlife guidelines. The following topics represent areas that may impact individual project costs and schedules.

#### **18.3.12.1**      *Nesting Birds*

In general, for any construction-related activities (grading/clearing, heavy equipment use, demolition activities, etc.) that occur between mid-March to mid-September, NREL EHS shall conduct a nesting bird survey prior to the beginning of construction activities. Ideally, NREL EHS should be contacted as soon as a construction project is planned. Whenever possible, construction projects should be planned to occur between mid-September and mid-April. NREL EHS shall be notified at least 14 days prior to the start of construction, to ensure the availability of staff to conduct the survey. Surveys shall be completed from three to seven days before construction, depending on local and species-specific breeding activities (consult with NREL EHS). Project delays of a few days to several weeks may occur if an active nest is found in the construction area, depending on the species, the nesting progress, the species relative tolerance to human/construction activities, and the amount of activity that will occur near the nest (consult with NREL EHS). Active nests may occur on the ground, in shrubs or trees, in onsite nest boxes, or in building entryways or open areas. If raptor (hawks, owls, falcons) nests are found, buffer zones from 200 yards to 1/2 mile shall be kept free of construction activities until the young leave the nest. Early coordination with NREL EHS can help mitigate issues before they arise. **Note:** Walking in ground-nesting habitat is permitted. If a bird is spotted flying from the ground, avoid the area by several feet, as a nest may be occupied or under construction.

#### **18.3.12.2**      *Snakes*

Subcontractors shall not pursue, capture, harass, harm, or kill wildlife, including snakes, encountered onsite. Minimal project delays (less than one hour) may occur if a snake is discovered in a project area. When a snake is discovered in an area frequented by workers or visitors, the observer shall call security at 303-384-6811 or 303-275-1234 to report its location. NREL EHS or Security and Emergency Preparedness Office workers shall relocate the snake to an uninhabited area of the site.

#### **18.3.12.3**      *Other Wildlife Species*

Subcontractors shall avoid adverse impacts to other wildlife species, including coyotes, deer, salamanders, bats, small rodents, rabbits, squirrels, swarms of bees, and any other form of wildlife encountered. Concrete washout pits/utility vaults and other similar structures shall be constructed and operated in a manner to preclude entrapment and drowning of wildlife. During construction and installation, such structures shall be covered nightly or otherwise protected to prevent wildlife from falling in, entrapment, or drowning. For shallow pits (i.e., concrete washout pits), one approach is to place a large piece of wood at an angle into the pit so that an animal can climb out if it falls in. For utility vaults, the entire vault shall be surrounded by plastic construction fencing at night and on weekends. The fencing should contact the ground as much as possible.



#### **18.3.12.4 Wildlife Corridor**

A wildlife corridor at the STM campus has been designated along the Middle Drainage. Construction that involves roadways, bridges, pedestrian trails and other features within 100 feet of the Middle Drainage Channel shall be designed to facilitate wildlife movement through the corridor. NREL EHS shall approve such designs.

#### **18.3.13 Preservation of Historical Resources**

In the event potential archeological items are unearthed or discovered during construction, work in the area shall stop. NREL EHS will make a determination within 24 to 48 hours if work in the construction site can continue. Potential archeological items may not be moved or stockpiled upon discovery.

#### **18.3.14 Wetland and Drainage Areas**

Work within jurisdictional wetlands requires permitting through the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. At this time, no jurisdictional wetlands have been identified at STM or NWTC. Work within non-jurisdictional wetlands requires approval from NREL EHS. Areas within your work site that hold water after storm events or snow melt may be considered non-jurisdictional wetlands. Please contact NREL EHS if such conditions exist on your construction site.

### **18.4 Subcontractor Responsibilities**

The provisions of this procedure apply to Subcontractors performing activities which have the potential to affect natural resources that include stormwater, wetlands, streams, air quality, vegetation and wildlife. The Subcontractor and all lower-tier subcontractors shall be responsible for implementation and compliance with all federal, state and local laws as well as NREL procedures as described above and referenced below.

### **18.5 References**

In addition to the regulations listed under Section 20.2, the following NREL procedures apply:

- NREL Laboratory Level Procedure [6-1.17 Aboveground Storage Tank Management](#)
- NREL Laboratory Level Procedure 6-1.18 Waste Management and Minimization
- NREL Laboratory Level Procedure [6-1.24 Spill Prevention Control and Countermeasures for the South Table Mountain Site](#)
- NREL Laboratory Level Procedure 6-1.25 Spill Prevention Control and Countermeasures for the National Wind Technology Center
- NREL Laboratory Level Procedure 6-1.20 Weed Management
- NREL Laboratory Level Procedure [6-1.21 Particulate Emissions Control for Construction](#)
- NREL Laboratory Level Procedure [6-1.28 Stormwater Pollution Prevention for South Table Mountain Site](#)
- NREL Laboratory Level Procedure [6-1.29 Stormwater Pollution Prevention for National Wind Technology Center](#)

- NREL Laboratory Level Procedure [6-1.19 Cultural Resource Protection](#)
- NREL Laboratory Level Procedure [6-1.12 National Environmental Policy Act Implementation](#)
- NREL Laboratory Level Procedure [6-1.15 Air Quality Protection](#)
- NREL Laboratory Level Procedure [6-1.22 Sustainable Landscape Design, Management, and Maintenance](#)
- NREL Laboratory Level Procedure [6-1.23 Natural Resource Conservation](#).

## **19 Temporary Traffic Control Requirements**

### **19.1 Applicability**

The requirements of this section apply to all Construction Subcontractors and lower-tier subs (hereafter referred to as “Subcontractor”) activities which have the potential to affect the safety of road users including motorists, motorcyclists, bicyclists, pedestrians and workers. Any exceptions to these requirements must be approved by the NREL Traffic Safety Authority Having Jurisdiction (AHJ) or his designee.

### **19.2 Regulatory Requirements**

Temporary traffic controls are addressed through the following statutes/laws/regulations and guidance documents:

- Manual on Uniform Traffic Control Devices (MUTCD) 2009 edition
- Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130
- OSHA 29 CFR 1926 Subpart G Signs, Signals and Barricades

### **19.3 NREL Specific Requirements/Permits**

In addition to the above regulatory requirements, all work activities shall meet the requirements identified in the NREL Temporary Traffic Control Manual for Roadway Construction, Utility Work, and Maintenance Operations. This manual shall serve as a site supplement to the MUTCD for work performed on NREL owned property. This includes South Table Mountain and the National Wind Technology Center. This supplement is not intended to replace the MUTCD, but to provide standard practices for specific conditions on NREL campuses.

#### **19.3.1 Temporary Traffic Control Plan (TTCP)**

The NREL Temporary Traffic Control Manual identifies the need for traffic control planning, it provides acceptable controls for typical applications and it identifies under what conditions a TTCP must be submitted to the NREL Traffic Safety AHJ for approval.

### **19.4 NREL Special Emphasis**

The subcontractor shall ensure that they are in compliance with the NREL Temporary Traffic Control Manual. This includes the submission of a TTCP to the NREL Traffic Safety AHJ, where required, as a part of pre-planning construction work.

### **19.5 References**

- Manual on Uniform Traffic Control Devices (MUTCD) 2009 edition
- Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130
- OSHA 29 CFR 1926 Subpart G Signs, Signals and Barricades
- NREL Lab Level Procedure 8-8.2 Traffic Safety Management
- [NREL Temporary Traffic Control Manual for Roadway Construction, Utility Work, and Maintenance Operations](#)

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